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AUTOMOBILE RACE AROUND FRANCE—THE ARRIVAL OF THE WINNER, M. R. DE KNYFF, AT SAINT-GERMAIN-EN-LAYE.

THE AUTOMOBILE RACE "TOUR DE FRANCE."

THE automobile race styled "Tour de France" was certainly the sporting event of the year. From the viewpoint of the construction of the automobile carriages, as well as of the art of driving the formidable vehicles, the event exceeded in importance anything that could have been expected. Organized by one of the great Parisian daily papers, under the auspices of the Automobile Club of France, the race of the Tour de France consisted of a trip divided into seven stages and to be made in nine days, a rest of twenty-four hours to follow the two hardest stages of the journey.

The first stage was from Paris to Nancy (174 miles), the second from Nancy to Aix-les-Bains (265 miles), the third from Aix-les-Bains to Vichy (229 miles), the fourth from Vichy to Perigueux (180 miles), the fifth from Perigueux to Nantes (224 miles), the sixth from Nantes to Cobourg (269 miles), while the seventh led the racers from Cobourg to Paris, or rather to Saint-Germain-en-Laye, the department of the Seine being prohibited to them. This last stage, the shortest one, comprised but 114 miles.

The start was made at Champigny on the 16th of July, and the majority of the racers registered took the Nancy road. Twenty automobile carriages, twenty-five motocycles and four phaetons contested in speed from the start, which was made at intervals of thirty seconds.

The first day, like the succeeding ones, was a surprise, not only from the standpoint of the resistance of the motors, but from that of the amazing pace kept up upon a road that was at times very difficult. It would take too long to narrate the innumerable incidents of the seven days of this memorable race; so let us merely say that the racers who were in the lead hotly disputed the first place with each other at every stage, and that the result was always doubtful, on account of the delays to which one and another of the vehicles was submitted in the repair of accidents along the route.

The lead was held by such experienced drivers as De Knyff, Girardot, Pinson, Chasseloup-Laubat, Charron, and others.

The most curious performance was that of the motocycles, which, against all hope, followed the pace of 36 miles an hour led by the carriages. As may be seen, we are far from the two and a quarter horse power tricycle that two years ago had trouble to make its fifteen miles an hour.

Although each arrival in the various towns terminating the stages was exciting, that which closed the race and established the definitive classification evoked among the Parisians a lively feeling of curiosity.

Saint-Germain-en-Laye is the starting and objective point of many of the bicycle and automobile races, but there never was an arrival that caused such an excitement in this quiet country place.

Since morning there had been passing through the town a genuine storm, of which the squalls were represented by the vertiginous passage of hundreds of automobiles that were making their way toward the gate of Hennemont, where the register was to be installed at about three o'clock.

Many spectators stationed themselves along the Quarante-Sous road in order to see the racers pass, but a still larger number of lovers of automobilism grouped itself at a few steps from the register, so that the starter, whose red flag was hoisted upon an automobile, was obliged to send a yellow flag (the signal to slow up) two hundred yards to the front, in order to prevent accidents.

At quarter past four a waving of the yellow flag announced a racer, and immediately a carriage made its appearance coming at full speed, and then abruptly stopped in the middle of the crowd, which, being anxious to see, did not even think of getting out of the way.

An outburst of applause greeted the victor, M. René de Knyff, who had kept the lead during the entire race, and who, calm and smiling, shook hands with his friends. Led to the register, the victor recorded the last signature and stated, with satisfaction, that he had made the run of 1,330 miles in 44 hours and 44 minutes.

At this moment new acclamations announced the arrival of Girardot, who, classed as third on the preceding day, took the second place from Count Chasseloup-Laubat, who, in the preceding classifications, had taken twenty-seven minutes' start of him. Girardot rode around nervously for twenty-seven minutes looking at the road, and these minutes seemed to him ages. Finally the starter notified him that they were exceeded and that he was classed as second. At this moment a cloud of dust announced the arrival of Chasseloup-Laubat, five minutes too late.

During this time the motocyclists began to appear, and Tart and Teste were classed second and first, the difference between the two not having been made up by the advance of Tart beyond his competitor in the last heat.

M. de Knyff is too well known to allow us to present him to our readers, but we are happy to mention a trait that honors the man and shows that in him humanity speaks louder than the passion of the sporting man. Driving the stage from Aix-les-Bains to Vichy, at a moment when M. de Knyff, close pressed by his competitors, was following a pace of more than thirty-six miles an hour, he saw at the roadside an overturned tricycle, and, at a few yards from it, the outstretched form of a man. The valiant driver put on his brakes without hesitation, turned short, and rode up to the victim. It was the motocyclist Williams, who had fainted and was giving scarcely any sign of life. De Knyff forgot the race and the precious minutes and made it his duty to look after Williams, despite the protests of the wounded man, who, having come to himself, said to his competitor: "Be off! You will get behind!"

It was not until after he had called for help and put Williams into the hands of the inhabitants of the country, that De Knyff resumed his way toward Vichy.

It was in order to preserve a remembrance of this act of good fellowship that a friend of the victor, M. de Lucenski, presented to him on his arrival a gold pin surmounted by a dog's head of labradorite artistically carved.

For the above particulars and the illustrations we are indebted to Le Monde Illustré.

ARRIVAL OF COUNT CHASSELOUP-LAUBAT.

THE CROWD ON THE QUARANTE-SOUS ROAD.

THE WORK OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.*

PRIOR to the year 1800 little was known of the properties of the materials of construction. Galileo had shown in 1638 that the strength of a rectangular beam varied with the square of its depth. Hooke in 1678 had announced the law that the stretch of a spring was proportional to the stress upon it, various authors had discussed the forms of beams of uniform strength, and Euler in 1744 had enunciated his formula for the resistance of columns under compression. Theory was far in advance of practice, for experiments had been so few and so imperfect that the elastic limit was scarcely recognized.

During the years from 1800 to 1850 great progress was made in the theory of elasticity, and a slow growth took place in knowledge of the properties of materials under stress. The introduction of railways and the consequent necessity of providing a firm roadbed and safe bridge structures gave a powerful stimulus to the investigation of metals, in order that ample security might be afforded with the greatest degree of economy. The methods of testing were, however, so imperfect that progress was slow, and, with the exception of the classic researches of Hodgskinson, the work of this period was mostly of value as a preparation for that of the future.

After 1850 large testing machines for special purposes began to be built, elongation and ductility began to be carefully studied, and soon after 1870 it was recognized by many manufacturers that physical tests of metals were imperatively necessary in order to secure uniformity of product. As these tests were multiplied and the records subjected to investigation, the knowledge was gained that the strength of a specimen depended upon its size and proportions and also upon the manner in which the load was applied. The term elastic limit assumed a new significance when it became recognized that it could be defined and measured in different ways. In short, it was found that tests of materials must be made in a similar manner in order to render the results comparable. This idea, although long recognized, has proved a difficult one to realize. It has been discussed by many engineering societies, some of which have attempted to formulate standard methods. Finally the International Association for Testing Materials was formed, in order to study the whole subject and endeavor to arrive at conclusions that should be authoritative.

In 1882, through the influence of John Bauschinger, a number of German experimenters met at Munich and discussed the question as to how uniformity in the methods of testing materials could be promoted. As a result of this meeting formal conferences were held at Dresden in 1884, at Berlin in 1886, at Munich in 1888 and at Vienna in 1893, delegates from other European countries being often present. The reports of the proceedings of these conferences, published in Bauschinger's "Mittheilungen," attracted wide attention, and the great value and importance of the discussions became universally recognized in engineering circles. In short, the movement assumed an international character.

In 1890, as a result of the international congresses of engineering held at Paris in the preceding year, the French government appointed a commission to formulate standard methods for testing the materials of construction. Its report, published in 1894 in four large volumes, is one of the most valuable contributions to the subject, but from the first it was recognized that ultimate conclusions could not be determined by a commission of one nationality, and accordingly, since 1895, the French government has given hearty support to the work of the International Association.

In 1895, as a result of the four preceding conferences, the fifth conference met at Zurich, all European countries, except Turkey, being represented. The United States government was represented by an army officer and the American Society of Mechanical Engineers by a delegate. At this congress the International Association for Testing Materials was formally organized, its object being, as stated in its statutes, "the development and unification of standard methods of testing for the determination of the properties of the materials of construction and of other materials, and also the perfection of apparatus for that purpose." This meeting at Zurich hence assumed an importance far greater than any preceding conference, and it may be called the first congress of the International Association.

At the Vienna convention of 1893 there had been appointed 20 committees on technical subjects, and reports from many of these were presented at the Zurich congress of 1895. These reports were published in the French and German languages in the official organ of the Association, called Baumaterialienkunde, the first number of which appeared in July, 1896. The work of some of these committees was continued, other subjects were proposed for future consideration, and a council was organized to transact the business of the International Association in the intervals between the congresses.

In 1897 the second congress of the International Association was held at Stockholm, there being present 361 members representing 18 countries. The United States government was represented by an army officer and a navy officer, and the American Society of Mechanical Engineers by a delegate. The congress continued in session for three days, reports of committees were presented, papers read and discussed, and plans outlined for the future work. It was resolved that the next congress should be held in Paris in the summer of 1900, and the council was authorized to appoint technical committees to make reports at that time on special problems relating to the objects of the Association.

At a meeting of the International Council held early in 1898 appointments were made of chairmen of 21 committees on technical problems, and the number of members on each committee from each country was assigned. It was also recommended, in order to expedite the appointment and work of these committees, that the members in each country should meet and form a national section of the International Association. In compliance with this recommendation a number of the American members met on June 15, 1898, and organized an American Section, whose first annual

* An address by Prof. Mansfield Merriman, of Lehigh University, Chairman of the American Section of the Association, at the second annual meeting, held in Pittsburg, Pa., August 15-16, 1899.

meeting was held at Philadelphia on August 27, 1898, and whose second annual meeting I now have the honor to address.

The membership of the International Association numbered 493 in 1895, 963 in 1896, 1,169 in 1897, 1,488 in 1898, and is now probably about 2,000. Germany takes the lead in regard to number of members, it having 387 in 1898, while Russia had 315, Austria 158, England 83, Switzerland 83, United States 68, Sweden 68, France 66, Holland 48, Norway 42, Denmark 39, Spain 36, Italy 35, and 60 from nine other countries. With regard to the American membership, it may be noted that it numbered 6 in 1895, 25 in 1896, 60 in 1897, 68 in 1898 prior to the organization of the American Section, 106 in February, 1899, and that it is now nearly or quite 125.

While the main object of the Association is to establish standard rules for testing, it is recognized that this cannot be done until a thorough knowledge is obtained of the properties of materials under varying conditions. Accordingly the work of some of the committees is to collect and digest the information now on record, or to make scientific investigations that will render present knowledge more complete and definite. Thus, there is a committee on the properties of steel at abnormally low temperatures, one on the relation of the chemical composition of stone to its weathering qualities, one to digest the work of previous conferences and conventions on the adhesion of hydraulic cement, one on the causes of the abnormal behavior of cements as to time of setting, and one on the protection of wood against the action of dry rot. Some of these subjects have already been discussed at the congresses of Zurich and Stockholm, and accordingly the reports to be presented to the Paris congress should contain positive additions to present knowledge.

There are advantages and disadvantages in doing technical work by committees. One advantage accrues through the harmonization of the different views held by individuals, whereby non-essentials are rejected and only fundamental methods retained. One of the disadvantages is that this process of harmonizing views takes time, causing reports to be long delayed, particularly with international committees. Some technical societies appoint committees with great reluctance, fearing that their reports may be regarded as official action. In the case of our international organization, no such fear is felt, and the report of a committee is to be considered from the same point of view as the paper of an individual member. Through the formation of the national sections, the work of the international committees can certainly be made more valuable and effective than ever before, for each national sub-committee, after having eliminated disagreements of its individual members, can work as a body to impress its views upon the other national sub-committees. In many cases an international agreement may be found difficult to make, but if made after such full discussion it will be sure to be authoritative and valuable.

The subject of the chemical analysis of iron and steel has been discussed in previous conferences and congresses, and at the Stockholm meeting of 1897 it was formally resolved to establish an international siderochemical laboratory at Zurich. It was stated that fifteen smelting companies and iron manufacturers had pledged themselves to contribute \$3,500 per year for this purpose, and that the Polytechnicum at Zurich had offered the use of four well equipped rooms. It was accordingly determined to open the laboratory in 1898, and an international commission was appointed to take charge of it and raise further funds for its maintenance. I am unable to state how fully this has been carried out, as no published accounts of its work have appeared. It is, however, to be doubted whether the establishment of chemical and physical laboratories falls properly within the scope of the objects of the association. If sufficient funds could be raised so that men of different nationalities might meet at such a laboratory to actually make analyses and tests, each criticising the others, while at the same time learning from them, then undoubtedly effective work would be done in harmonizing differences and perfecting standard methods. It is to be hoped, if the establishment of the sidero-chemical laboratory at Zurich proves to be successful, that it may tend to further this method of research. It is, however, the opinion of many members that results as good, if not better, would be secured by arranging systematic schemes of investigation and distributing the actual work of analysis or testing among the laboratories of different countries.

Since the above was written a circular of the International Council has been received containing the information that probably arrangements cannot be made for holding the congress of the Association at Paris in 1900. It appears that the authorities of the Paris Exposition have the right to control the organization of all congresses held in that city in that year, and that they have announced one to be held on the subject of materials, and appointed officers to conduct the same. The subject will be discussed at this annual meeting, and expressions of opinion are desired as to whether it is best to abandon our congress of 1900, in order to co-operate with the one announced by the authorities of the Paris Exposition, or to hold it at London during the week preceding.

In conclusion, it is with pleasure that I congratulate the American Section upon its activity and the Association itself upon the bright prospects before it. The undertaking inaugurated by Bauschinger and his associates bore good fruit at the conventions of 1884, 1886, 1888 and 1893, and prepared the way for the Zurich meeting of 1895, which was at the same time the fifth convention and the first congress. At the Stockholm congress of 1897 the true international work was begun, and the problems there proposed are now the subject of careful study in all parts of the earth. Let us hope that the reports to be presented at the future congresses will be such as to add to the present stock of knowledge, prove advantageous to both producers and consumers, and assist all engineers in economically using the materials and forces of nature for the benefit of man.

Some instructive observations on the temperature inside tree trunks were recently communicated by Mr. R. A. Emerson to the Academy of Sciences, Nebraska. When the trunks and limbs of trees are shaded, their temperatures, if above that at which water freezes, vary according to temperature of the outside air. Moreover, in the shade, tree temperatures above the freezing point of water are higher than the air temperatures when both are falling and lower when both are rising. When exposed to bright sunlight, however, the tree temperatures, in circumstances otherwise similar, are higher than the air temperature, not only when both temperatures are falling, but are often higher also when both are rising. One side of even a small limb may consequently have a temperature much higher than the air and the opposite side a temperature lower than the air.

LATHE CENTER GRINDING APPARATUS.

We illustrate on this page a very handy little grinding attachment for a lathe, now being introduced by Mr. F. J. Tiffin, of 3 Great Winchester Street, London, E. C. As shown in Fig. 1, the attachment is being used to grind a lathe center, the necessary motion being obtained from a friction pulley driven by contact with one of the steps of the belt cone, as shown. This arrangement, says Engineering, to which we are indebted for the engravings and article, is perhaps shown still more clearly in Fig. 5, where it will be seen that the frame carrying the pulley is provided with a hook which can be slipped round the sleeve of the back gear. A flexible shaft is used to connect this pulley with the spindle carrying the emery wheel used in grinding. By substituting the spindle shown in Fig. 4, the appliance can be used for internal grinding. The principal peculiarity of this attachment is, however, to be found in the means taken for speeding up the grinding spindle. This is not coupled direct to the flexible shaft, but is driven through the intermediary of an epicyclic train, which causes it to make six turns for each one of the flexible shaft. This epicycle train acts purely by friction, and consists of four flexible steel rings compressed between the grinding spindle and an outer fixed case, as shown in Figs. 2 and 3. These rings are carried round on rollers mounted in spindles fitted into a flange keyed to a main driving shaft, as shown. The gear, it will be noted, is completely inclosed, and is thus thoroughly well protected from the intrusion of emery dust.

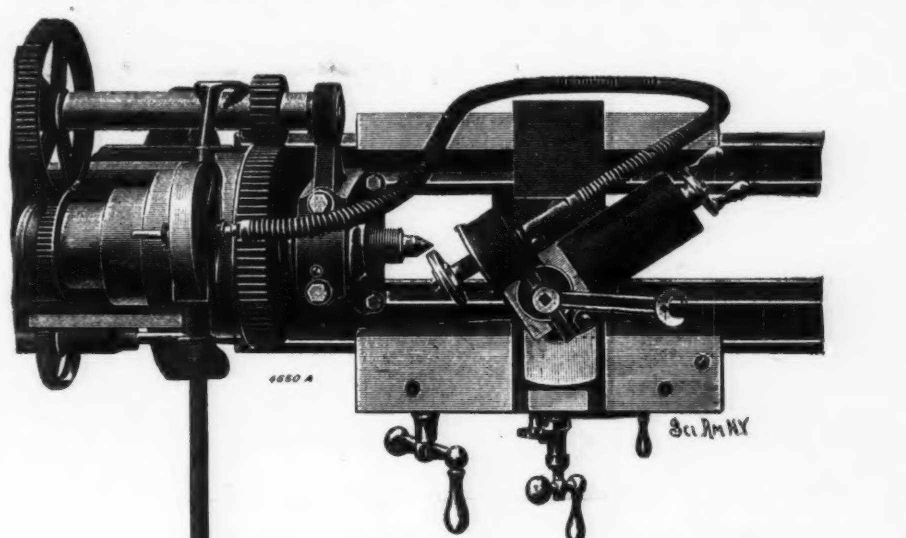
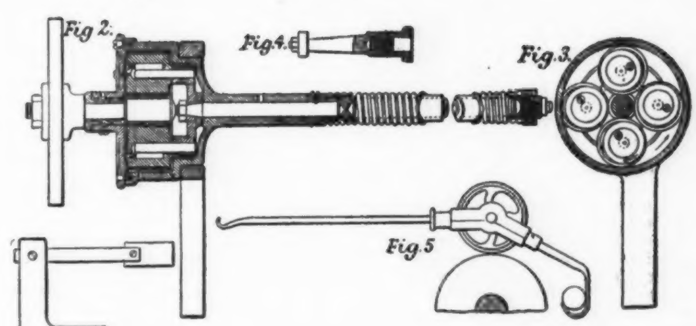


Fig. 1.



LATHE CENTER GRINDING APPARATUS.

PHOTOGRAPHIC SURVEYING.

In a recent communication to the Paris Academie des Sciences, M. Laussedat states that the idea of using the camera for topographical surveying originated in France, and almost immediately after Daguerre's discovery, the possibilities of the photographic method were foreseen by Arago and Gay-Lussac. Progress was, however, hindered by the then state of practical optics and photochemistry. In Europe the best examples of the method are to be found in the work done in the topographic surveys of portions of Italy and Austria-Hungary, while the Germans adopted the plan to a limited extent during the war of 1870–71 for surveys round Strasburg and Paris. More recently a Photogrammetric Institute has been established at Berlin, the work of which is more especially devoted to the preparation of plans and elevations of the national monuments of Prussia and the secondary states from photographs taken under suitable conditions. It is in Canada, however, that photographic surveying has been adopted on the largest scale. In certain portions of the Dominion surveys by any of the usual methods are quite impracticable, owing to the prevalence of fog and cold. With the camera, however, it is possible to get a complete record of the topographic features in a few minutes, from which maps can afterward be prepared. M. Laussedat states that he has received from Mr. E. Deville, the Surveyor-General of Canada, a number of such maps. One of these, drawn to a general scale of $\frac{1}{80,000}$ inch (about 0·78 inch to the mile), refers to a district of 1,350 square miles, in which it is proposed to construct large impounding reservoirs for irrigation purposes. The plan followed was to fix by ordinary triangulation the positions of certain carefully chosen summits, which were then used as photographic stations. At the actual reservoir sites more photographs were taken, and the levels deduced from these checked by a number taken in the usual way with staff and stadimeter level. In the Klondike region the district surrounding and including Dawson City has been similarly surveyed, the work being plotted at Ottawa from sixteen photographs taken by Mr. Ogilvie. In this case there were three photographic stations, the heights of which were 2,870 feet, 3,700 feet, and 3,450 feet respectively, as determined from aneroid readings.—Engineering.

[Continued from Supplement, No. 1232, page 19747.]

ELEVATORS.*

By Charles R. Pratt, Montclair, N. J., Member of the Society.

In the beginning of this paper I classified some of the salient features of elevators, but have only thus far dealt with the one subdivision of "Safety," which involves the car alone. As the balance deals entirely with the hoisting apparatus and is too much involved to treat in the same specific manner, I will endeavor to describe in order of their evolution the various types that have been in general use.

The generic trade classification of these types are Drum, Hydraulic, and Screw. "Drum" implies all hoisting machines in which the ropes or chains leading from the car are fastened to and wound upon a drum. "Hydraulic" includes cylinders having their pistons connected to the car by ropes, or acting direct on the car, when they are called plunger elevators. "Screw" is the trade name for hoisting machines transmitting motion to the car by means of a nut and screw.

Drum elevators are the earliest, the most universal, and the most simple form of elevator ever built. The drums were first driven by worm gears, in the first instance for safety and smooth motion only, but the low efficiency of the early forms of worm gears caused some makers to use a spur-gear drive, which is more expensive if well built and never as safe or as smooth running as the worm gear. Modern improvements in worm gearing have raised its efficiency from 30 per cent. to over 80 per cent. in elevator gearing, and, although it can be built for less cost than spur gears and is equally as efficient, there are some concerns still making spur-gear elevators.

The drum elevator is especially convenient to overbalance, and can be placed in the top of the hoistway with one face of the drum plumb over the center of the car and the other face over the counterbalance, the car ropes fastened at one end of the drum grooves and the counterbalance ropes at the other end of the same grooves, the car ropes occupying the entire surface of the drum when the car is up, and the counterbalance ropes following alongside of them occupying the en-

* Presented at the Washington meeting (May, 1899) of the American Society of Mechanical Engineers, and forming part of volume xx. of the Transactions.

tire drum surface when the car is down. The counterbalance is made to balance the car with its average load, in which case the elevator has no gravity work to perform, and makes the most economical type of hoisting apparatus.

This arrangement, however, of placing the machine in the top of the hoistway is peculiarly adapted to electric elevators, when the power is easily conveyed by electric conductors to the motor, and was not always practicable with belt-driven elevators and seldom used with steam hoisting engines. But whether placed in the top, bottom, or remote from the hoistway, the drum machine is most always overbalanced; even if it takes a dozen sheaves to do it, the saving in gravity work compensates for all friction and first cost so incurred.

The form of worm gearing to be used on drum elevators involves the following conflicting considerations:

Efficient angle of worm increases cost and diameter of worm wheel or the cost and size of electric motor, difficulties of electric control, and the danger of running down at too high speed. Hindley worm gears are more durable and efficient than any other style and can transmit more power than any other worm gears of equal size.

The interlocking right and left hand worm gears, taking up their own thrust, were better than a single worm and gear until ball or roller thrust bearings were perfected as they are to-day. Now, with a roller thrust having less friction loss than a worm and gear, the efficiency of this double-worm gearing cannot be as great as a single-worm gear with roller thrust, provided the single-worm gear is not overloaded.

The writer was the first to design and use right and left hand Hindley worm gears, interlocked by spur gears bolted to them, as the Hindley gear teeth are straight like the thread of the worm, their only curve being to conform to the helical surface of the worm, and therefore cannot mesh together. All other forms of double-worm gearing mesh the worm gears together; their angularity being reversed at the worms coincide where they mesh together like spiral gears, some using unfinished cast teeth and others regular involute teeth cut straight across at the proper angle with faces wide enough to admit a small-diameter hob cutting a surface for the worm in the center of the faces and leaving enough for spur-gear drive at the ends.

To make a perfect job, these teeth should first be cut by a spiral gear cutter, but I do not know of any so made, and, like the Hindley gear, it might be an ultra-refinement for commercial use. However, as in all other problems in mechanics, we know what is best long before we obtain it.

The double Hindley geared elevators referred to are clearly shown in the following drawing, Figs. 12 and 13.

They certainly appeal to mechanical engineers, and such plants as the Siegel-Cooper store in New York city and the Central London Railway in London have selected this type on account of its superior durability; the last-named plant using 49 of these elevators, operating cars having floor areas of from 117 to 256 square feet each, averaging 13 tons total load on the ropes for each car.

As before stated, there are some objections to an efficient angle of worm, some of them being due to commercial limitations of electric motors. We may as well recognize the fact that for the future no other form of power need be considered for this type of elevator; probably 90 per cent. of them are now being built electric.

The conditions limiting the angle of the worm are the diameter of the gear, the speed of the motor, and the ability of controlling the speed of a car that can easily drive the worm gear.

The diameter of the gear is limited by the diameter of the drum, and the diameter of the drum is limited by the range of work intended for the particular machine, which in general practice does not exceed 36 inches for the smallest drums used for the heaviest loads that the machine has power to handle; the lighter loads requiring higher speeds are operated by drums of larger diameter. Another important limitation to the diameter of the gear is the cost of the gear itself and of all parts of the machine that would be increased in proportion. Such a gear would in turn limit the variation of drum diameters, as drums smaller than the gear require extra idler sheaves to lead the ropes up between car and hoistway when the machine abuts against the hoistway wall.

The gear for the average drum elevator is therefore practically limited to a diameter that will, with its gear case, not extend beyond the flanges of a 36-inch drum; such gears are about 30 inches in diameter. Having determined this, we can now consider what angle of worm can be obtained at the required car speeds and limitation of motor speeds. The duty on drum elevators ranges from 2,000 pounds at 300 feet per minute to 6,000 pounds at 100 feet per minute, varied by drums from 36 to 60 inches diameter, and motor speeds from 470 revolutions per minute to 1,000 revolutions per minute. This, of course, covers differences in worm-gear reduction arbitrarily determined by the designer.

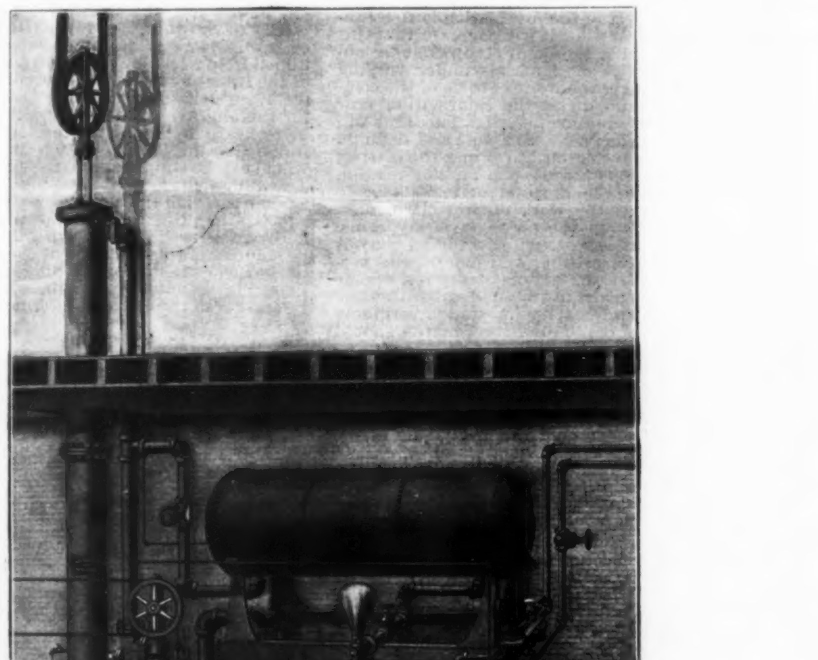


FIG. 16.

Assuming 470 revolutions per minute as the lowest motor speed consistent with the cost of a motor of the required horse power, the cost being in inverse ratio to its speed, and we get a reduction of 46 to 1 to obtain 100 feet per minute on a 36-inch drum, 24 to 1 for 300 feet per minute on a 60-inch drum; and a reduction which the writer has found to be very successful is 29·5 to 1 for 200 feet per minute on a 48-inch drum. This latter is that shown in the Hindley gears in Figs. 7 and 8 and has an angle of 12°, using a double-threaded worm and 59 teeth in the gear. Seventy per cent. efficiency has been obtained with this gear from current delivered to motor to work done at car, giving the gear over 80 per cent. efficiency. One elevator with this gear is being run as what we call a gravity machine; i. e., the car is under-balanced and drives the motor connected up as a dynamo in its descent, starting promptly as soon as the brake is released. While it has been considered dangerous by most elevator builders to use a gear that the car can drive, the writer has no reason to doubt the safety of this hoisting machine, which has a brake of ample capacity, applied by a spring and released by a magnet, which lets go and applies the brake whenever the electric current is broken, either by an overload or by a switch operated by a centrifugal governor when the speed exceeds that which it is regulated for.

While this particular instance obtains an efficient angle of worm, the same conditions do not always exist in drum elevators. In the first place this high efficiency is in part due to the Hindley gear; and, secondly, the low motor speed is commercially due to the horse power of the motor, which is the greatest that is used on drum elevators, speeds of 800 revolutions per minute being more often used than 470 revolutions per minute; for these car speeds and gear diameter reduce this angle considerably, but not in the same ratio as the revolutions per minute reduction, because with the reduction of load on the worm its diameter can be reduced and a greater angle maintained, usually between 8° and 9°, and an efficiency of about 70 per cent.

Recent data on worm gearing indicate 45° as the angle of maximum efficiency, and a curve plotted from the data obtained rises abruptly to about 15° and then flattens out to 45°, which gives these elevator gears a low rating.

The angles here given of 8° and 9° are those generally used in the best elevators on the market; there are many others in use where the angles are less than 6°, and the total output of such elevators is not over 30 per cent. of the current used.

Chronologically the hydraulic elevator follows the drum type, but antedates by many years the electric drum elevator.

The simplest form of hydraulic elevator is that called the plunger type, which consists of a ram working in a vertical cylinder with stuffing box at the upper end. While this has been exploited for high rises in a telescopic form, its practical use is for sidewalk elevators, or eleva ors where the car is only a platform rising to a floor which permits of no continuation of the guide rails or car frame, in which case the stability of the ram holds the car platform level under unbalanced loading. Such elevators seldom rising over 30 feet, no telescopic arrangement is necessary, and the cylinder can be bored its full length into the ground to allow the platform to descend to the lower floor.

There is but one other class of hydraulic elevator, aside from those which were unsuccessful experiments, or which are now being experimented with, and this is built with either a vertical or horizontal cylinder as is best suited to the building; the vertical cylinder, being the better type, is always used where it can be installed. The view, Fig. 15, illustrates the construction of this elevator very clearly.

The motion of the piston is controlled by the exhaust port, the pressure being always on top of the piston; raising the piston valve opens the exhaust and leaves pressure on the top of the piston only; lowering the valve admits pressure on both sides of piston, and the load raising it circulates the water from top to bottom of cylinder through pressure and exhaust ports. The piston valve, as here shown, closes the exhaust port from both pressure and discharge connections, holding the piston between a closed port on one side and the pressure on the other. The main piston partly cuts off the ports at each end of the cylinder, to check its speed before striking the cylinder heads in case the piston valve should fail to work. This piston valve is controlled from the car either by a shipper rope direct, a shipper rope connected to a pilot valve, which in turn operates the piston valve; or a traveling shipper rope, operated by a lever in the car, as shown in Fig. 15, is connected to a pilot valve operating the main piston valve. To stop the car at the limits of its travel, a

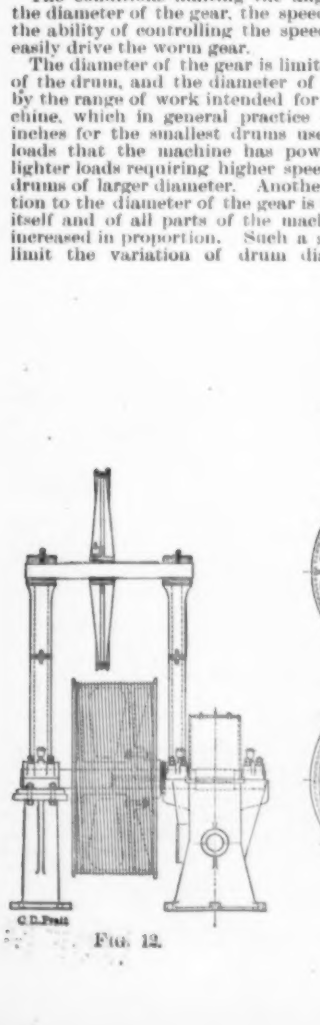


FIG. 12.

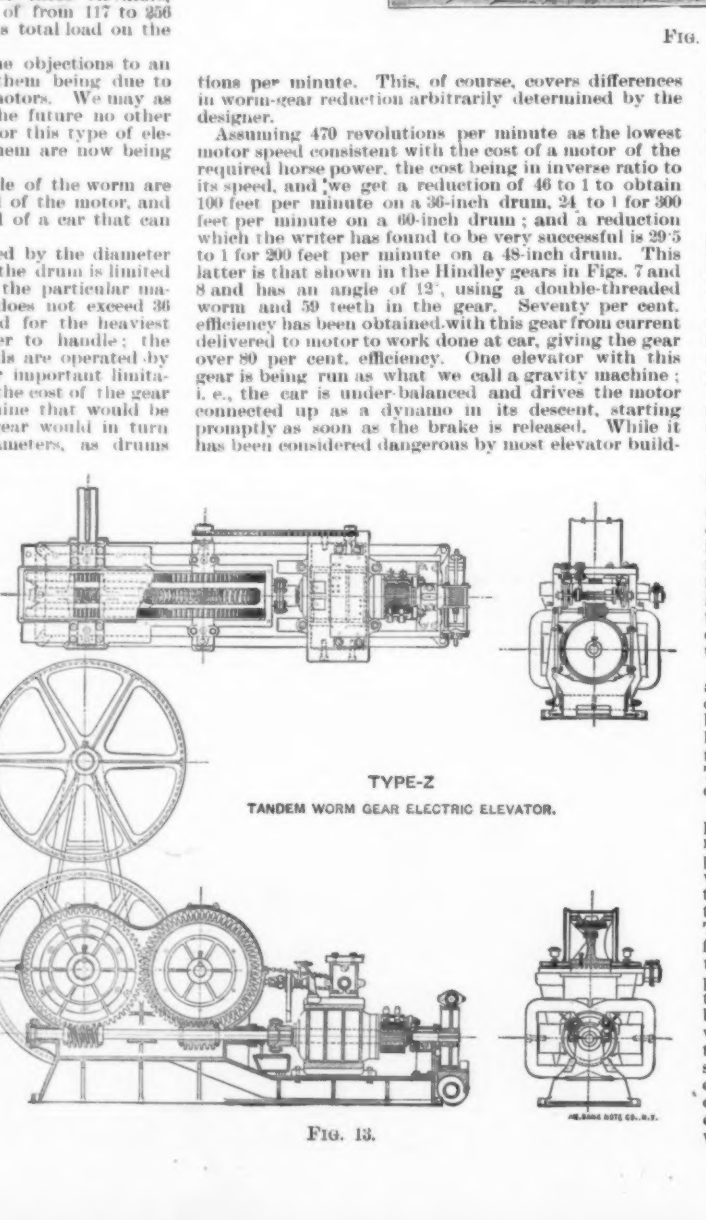


FIG. 13.

shipper device attached to some part moving with the main piston, closes the piston valve at the proper point of the car travel.

The object of maintaining a circulation of water from top to bottom of piston through the pressure pipe and valves is to balance the atmospheric head of water and leave the effective pressure on the piston the same during all parts of its travel, which can be done up to 30 feet piston travel.

This is not needed in horizontal cylinders, and they therefore have water on one side of piston only, using the same port for pressure and discharge, and a drip pipe on the other side of the piston.

There are two general types of these horizontal cylinders, one having tension and the other compression piston rods. The tension rods, being on the water side, require stuffing boxes, while the compression rods, usually in the form of one or two large wrought-iron pipes, are on the open end of the cylinder and require no packing.

These cylinders are usually of large diameter, shorter and higher geared than the vertical type. By higher gear I mean a larger number of multiplying sheaves, which in horizontal machines usually multiply the piston travel by 10, giving 10 feet car travel for every foot of piston travel.

The advantage of the vertical cylinder over the horizontal is in the counterbalancing effect of the piston and parts moving with it upon the car, which, being carried on a solid column of water, do not tend to teeter the car as a free counterbalance does when the car is stopped in its ascent and the momentum of the free counterbalance raises the car after the hoisting power has been cut off. Such counterbalances easily raise a car, having a speed of 500 feet per minute, 6 feet beyond the point when the hoisting power cuts off, and of course let the car fall back that distance and teeter (to use an elevator term) several feet up and down before coming to rest. This is only avoided by fine valve adjustment and taking plenty of distance to stop in.

Another cause of teeter is the whip of the ropes on horizontal machines, which is not common to the vertical; this is greater in the compression than in the tension piston rods, as the ropes on the former pass around the cylinder from the multiplying sheaves anchored at the water end to the traveling sheaves at the other end, or nearly double the distance of the tension piston rod type, where the traveling sheaves meet the anchored sheaves at one end of their travel.

We must pass over valve design and construction as matter involving too much detail for the scope of this paper; enough to say that no branch of hydraulic machinery has developed the variety of ingenious devices employed in controlling hydraulic elevators, and by no other means can an elevator car be better handled.

To avoid transmitting pump pulsations to the car, and also for storing power to use after the pump is stopped, gravity tanks, pressure tanks, gravity pressure tanks, and accumulators are used.

The gravity tanks which used to decorate the roofs of buildings are seldom used now; the pressure tank in the engine room, as shown in Fig. 16, came next, accumulating air pressure over the water line for any amount required, air being mixed with the supply by a valve to maintain the proper water level. Placing this tank on the roof as a gravity pressure tank permitted the air from the cylinder to escape more readily and gave greater storage of power by using gravity pressure for light loads as the air pressure reduced.

Accumulators are chiefly used with high pressure plants, but pressures over 250 pounds per square inch are not often used.

For pumping water into these tanks all kinds of pumps are used, electric or gas engine power pumps, single-cylinder, duplex, compound duplex, and high duty pumping engines, according to the size and character of the plant; compound and high duty pumps being economical only where enough elevators are running to give the pumps a steady load.

The electric elevator invented and built by the writer in 1888 and 1889, so far as the writer or those associated with him at the time knew, was the first electric elevator ever built.

I had simply taken hydraulic-elevator sheaves, mounted them in a suitable frame, and pulled them with a nut and screw instead of by their usual hydraulic cylinder and piston. The screw was driven through a double spur-gear reduction by a Thomson-Houston electric motor. The screw had two threads of one-half inch square section, 2-inch pitch and 4-inch outside diameter; it carried a bronze nut covering twelve threads.

(To be continued.)

A remarkable steel pipe has been put up at Modane, over the river Arc. It will be remembered that this Alpine stream supplies power to the various electric and chemical works of the district. The pipe in question belongs to the Société Electro-Magnétique Française de la Praz, of which Héroult is the director, and forms part of the hydraulic conduit which takes 9,000 horse power to that company. The pipe has a length of 1,000 meters and a diameter of 2·4 m. (about 8 feet). The water stands under a pressure of 72 m. (236 feet), and the idea to take the conduit over the river, quite unsupported, was certainly very bold. It has been done by Lapouche, engineer of the Bietrix works, on the suggestion of Héroult. The river is very boisterous, and the bed so irregular that a support could not well be erected; and since the pipe has already lived a year, the idea may be said to have answered. Lapouche has described the construction in a paper which he read before the mining engineers of St. Etienne. He did not enter into the particulars of his calculations. The Revue Technique argues that it would have been wiser to construct the conduit in armed cement; the problem would have been simpler, and the structure safer. To anyone not knowing the particulars, the case may appear doubtful.

At the Paris Exhibition the United States railway exhibit consisting of cars, locomotives, railway machinery and appliances of every kind, will be made in the buildings provided for this purpose at the Bois de Vincennes. There will be at least sixteen American locomotives. Steel cars and other recent developments in American railroading will also be properly represented.

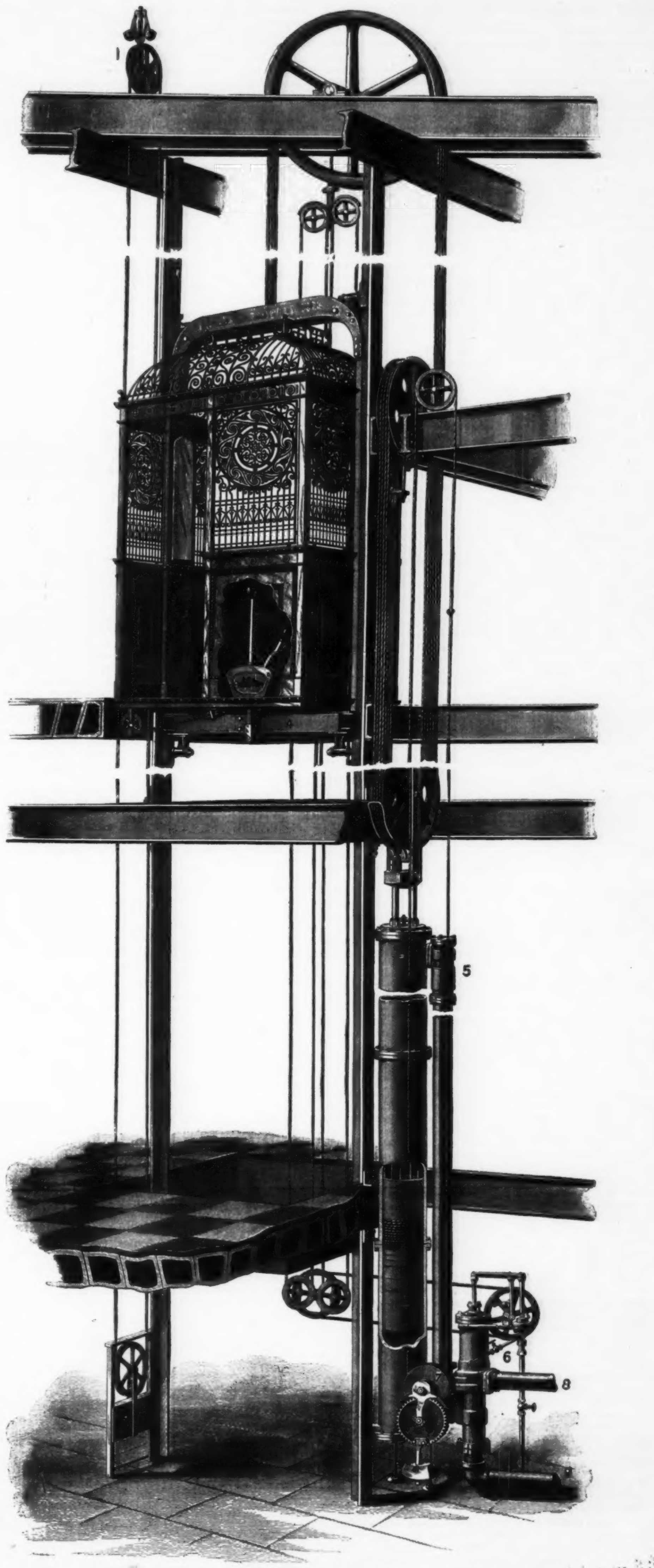


FIG. 15.—HYDRAULIC ELEVATOR OF THE VERTICAL CYLINDER TYPE.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Crops in Russia.—Consul Heenan, writing from Odessa under date of June 2, 1899, confirms his report of May 20, in regard to the failure of crops in southern Russia. Rain has not fallen to any extent, and cattle have been turned into the rye fields, all hope of saving this cereal having been abandoned. The yield of winter wheat will be far below the average; spring wheat will also be less than usual; oats and barley promise light crops. The consul adds the following particulars in regard to the affected districts:

The province of Cherson contains 17,495,685 acres of land, with a population of 2,732,832. It has eighteen cities, of which Odessa with 410,000 inhabitants, Nicolaiev with 100,000, and Cherson with 70,000 are the most important. The province of Bessarabia, with an area of 12,009,856 acres, has a population of 1,993,436. The largest town is Kishinev—110,000 inhabitants. The province of Taurida contains 14,919,974 acres, with a population of 1,443,560. The famous Crimea forms a part of this province. Here the culture of the vine reaches its highest development, and Crimean wines are well and favorably known all over Russia. The province of Ekaterinoslav has an area of 15,665,777 acres and a population of 2,112,651. The mineral resources are enormous, and millions of foreign capital are engaged in developing them. The province of Poltava contains 12,329,914 acres with a population of 2,794,727. The province of Kharkof has 13,463,522 acres and a population of 2,509,811. The city of Kharkof has 180,000 inhabitants. The Don Cossack territory contains 40,660,808 acres and a population of 2,575,818. The Kuban territory, with an area of 22,840,040 acres, has a population of 1,922,770. The provinces of Kief and Podolia are the richest agricultural districts in European Russia. Kief contains 12,592,574 acres and has a population of 3,576,125. Kief, the largest city, has a population of 250,000. In 1898, 311,982 acres were sown in beet root, yielding 1,500,768 tons of beets, from which 167,975 tons of sugar were manufactured. The province of Podolia contains 10,383,294 acres, with a population of 3,031,513. Podolia had in 1898 254,471 acres sown with beet root, which yielded 1,330,100 tons of beets, from which 151,862 tons of sugar were manufactured. The province of Volhynia has 17,727,411 acres, with a population of 2,997,902. This province planted 62,076 acres in beet root in 1898, which yielded 330,671 tons of beets, giving 39,694 tons of sugar.

Failure of the crops in southern Russia is imminent. A line drawn on the map from Kief to the southern part of the province of Samara, and thence, in a northerly direction, following the course of the River Volga, to Kazan; thence west to Moscow, and south again to Kief, will give a fair idea of the area within which more or less famine exists. It would almost seem as if European Russia might be dismissed as a factor in successful agriculture. The climatic conditions throughout this area are of so uncertain a character as to be a constant source of anxiety and danger to the farming population. The widespread misery is appalling.

Under date of June 19, Consul Heenan adds that reports from central and eastern Russia indicate similar conditions as to shortage of crops. The province of Saratov has suffered severely from lack of rain. This province contains 20,879,357 acres and has a population of 2,419,844. It has ten cities with a population of over 10,000, of which Saratov (138,000) is the largest. The average crop of wheat (spring) has been 10,500,000 bushels; of oats, 30,938,000 bushels; of rye, 35,036,000 bushels.

Exporters at Odessa are in anything but a cheerful frame of mind and foreign houses contemplate closing for the season. There is undoubtedly, says the consul, considerable wheat held back by the farmers; but this does not indicate that they are in a prosperous condition. Nearly all are heavily in debt to the government.

Suggestions for Exporters to Germany.—Almost daily, letters reach this consulate-general from United States manufacturers asking how to proceed to find a market in Germany, for addresses of German firms, or for local agents, says Simon W. Hanauer, Vice-Consul-General at Frankfort. Desiring to aid in the expansion of our country's trade, I give a great deal of my time to personal interviews with German dealers, etc., but my experience teaches me that these efforts to gain markets are, in the main, futile. The American manufacturers who have been successful in acquiring a large export trade to Europe are those who have sent agents from home to exploit and work the foreign fields. These agents should not only be familiar with the character, quality, and technical features of the products which they offer for sale, but they must have culture, business tact, and full command of the language of the country in which they will operate. We have plenty of such young men who were born or educated in European countries; these are the proper pioneers to open a path for American exports. It is a mistake to send out persons who speak English only, or who are unacquainted with European customs, social as well as commercial.

In giving the agency of American goods to German firms or individuals, our manufacturers and exporters have no guaranty that their interests will be protected or properly pushed.

We hold yearly industrial exhibitions in our own country, each of which costs many millions of dollars. If this money were expended in holding expositions in foreign countries, the results would be more profitable to our business interests and would increase our export figures quickly and largely.

Each exposition should comprise only one leading line of goods and should be migratory, remaining in the most suitable center of each country for six months, and then moving to another. The ablest representatives of our trade should act as exhibitors, canvassers, and selling agents.

Furniture in Germany.—Vice-Consul-General Hanauer writes from Frankfort, June 12, 1899:

There are no factories in Germany where cheap furniture is produced; it is made in small quantities at the workshops of individual joiners, who are supplied by wood-working establishments with the different parts in an unfinished state. These joiners work at a very cheap rate. It may pay American manufacturers to export high-class articles of wooden furniture to Germany, provided these are tasteful in design and superior in finish to those made in Germany. They should be of superior workmanship and solidity, and, if anything, somewhat cheaper in price than similar articles of German make. It must be taken into account that such American furniture will have its original cost price increased by about 20 per cent. of the selling valuation here, owing to the cost of packing, freight, insurance, and the German import duties. The usual terms for selling furniture in Germany are three months' credit; if payment is made on delivery of goods, a discount of 3 per cent. is customary. Frankfort is a large market for the sale of furniture, and many houses are here engaged in this line.

Proposed Railway Construction in Formosa.—I have been unable as yet, says United States Consul J. W. Davidson, of Tamsui, to obtain any detailed information regarding the new railway line to be constructed in the island, as Chief Engineer Hasegawa, the officer in charge, is at present in the south. Only 2,000,000 yen ($1,000,000) has been appropriated for the year's work, and, I am informed by the chief of the communication department, it will be expended as follows: Work will be at once commenced at Takow on the Takow-Tainan branch, a line 28 miles in length. The land is quite level, and the work presents no difficulties, save the bridging of two small rivers. Trains will be running over the Takow branch in two years.

The present northern line runs from the Tamsui River in a southerly direction 40 miles to Hsinchiku (Teckcham). It was built by the Chinese and completed in 1893. From the Tamsui River opposite to Twatutia, the foreign settlement, the line runs over nearly level ground for some 7 miles. It then ascends a table land, on a maximum gradient of 1 in 30, and for the rest of the distance, with the exception of a few miles outside of Hsinchiku, it zigzags through the hills on the right side of a picturesque valley, up and down grade as though built on the model of a corkscrew. It has always been unsatisfactory, and portions of the line have been frequently destroyed by storms and freshets. Formerly, a bridge across the Tamsui River permitted the trains to run into Twatutia; but this, as well as several bridges a few miles from Hsinchiku, were destroyed during last year's great typhoon, one large iron bridge being carried 87 yards by the force of the wind and current. At present, therefore, the line does not touch either of the original terminals.

The Japanese find that this line must be almost entirely rebuilt. A new bridge nearly 2,000 feet in length and costing some 800,000 yen ($400,000) will be constructed across the Tamsui River at Twatutia, and the route will follow in a general way the original road, though while passing through the hills it will be on the left side of the valley and by the aid of two tunnels and many cuttings will be much straighter than the old line. The bridge will be commenced this year, and the line probably finished in two years. From Hsinchiku (Teckcham) to Tainan is 145 miles, and it is the intention to build the railway between these two points as soon as the work mentioned above is completed. This line will require numerous and expensive bridges and some thirteen tunnels. When completed it will give a railway service from Kelung to Takow, a distance of 205 miles.

I am pleased to be able to state that the chief of the communication department informs me that in all probability the locomotives, rails, and bridge material will be obtained from the United States, and that the order will, he believes, go to the Carnegie Company, of Pittsburg. I am unable at present writing to give information as to the extent of this order, but will write on the subject later. The gage of the present line is 3 feet 6 inches, the rails 36 pounds, and the ten locomotives used are of English and German manufacture. The new locomotives will be heavier than the ones at present employed, and the rails 60 pounds.

Agriculture in Mexico.—Mexican farming is widely different from that in the United States. Irrigation is necessary in the greater portion of this country, and, on account of the scarcity of water, a large extent of land cannot be utilized, says Consul-General John K. Pollard, of Monterey. When the owner of land has sufficient water for the purpose indicated, he holds on to his property and rarely can be induced to sell, as it is of permanent value to him. For the last three hundred years large tracts of land have been owned by individuals or families who have spent heavy sums of money for canals and dams in order to make them productive. On account of this and the attending expenses of irrigation, there are fewer small farmers in Mexico than there are in the United States. Until recently, farming in Mexico has been on the primitive order, but the Mexican is an expert in irrigation, and if he can get the water his land becomes fertile and yields generously. During the last two decades, decided improvements have been accomplished through the introduction of modern implements into farming in Mexico. The increase in production corresponds to the improvements in farming apparatus. The great railroads of the country have been important factors in this advance, enabling farmers with a surplus of production to ship to those less fortunate.

The cost of labor is from 25 to 50 cents (12 to 24 cents in United States currency)* per day, depending on the locality. There are two crops of corn a season, upon which the farmer averages $50 ($24.05) per acre gross. Sugar cane, turned into piloncillo, or brown sugar, averages from $150 to $200 ($72.15 to $96.20) per acre gross; beans, from $60 to $80 ($28.86 to $38.48) per acre; rice, from $75 to $100 ($36.08 to $48.10) per acre; all other products realizing correspondingly high prices. Thus it will be seen that the profits of the farmer must be large. Hay is not made in any great quantity, but corn fodder is sold to advantage. Baled oat and wheat straw sells at from $50 to $60 ($24.05 to $28.86) per ton. Adjacent to cities, a lucrative trade is carried on in green barley and corn, which are cut before maturity and delivered in the cities to owners of horses and cows.

Cattle raising is, and has always been, a profitable business in Mexico, consequent upon cheap labor, low taxes, and the large tracts of cheap land which are suitable for grazing only. Until recently, no attempt has been made to improve the stock; but certain large cattlemen have now undertaken to do this, and steady improvement is certain henceforth. The demand created during the late war with Spain and the high prices which obtained in the United States increased the price of cattle to such an extent that the northern portion of the country has become depopulated of its stock, which, it is said, will take several years to replenish. This means a continuance of high prices in cattle in that quarter.

Dairy farming in the neighborhood of large cities is lucrative, milk selling at 50 cents (24 cents) per gallon, and butter at 75 cents to $1 (36 cents to 48·1 cents) per pound. Those engaged in this business make money rapidly.

Fruit and vegetable farming is beginning to attract attention. Formerly, this amounted to simply enough for the home market. Now, an effort will be made to supply the United States with early fruits and vegetables. The movement is in its incipiency, but it is destined to grow into large proportions. Oranges, lemons, tomatoes, beans, etc., are produced in Mexico from four to eight weeks earlier than in the United States. Hence, this will be a profitable business in the near future.

Wheat is cultivated in the high tablelands of Central Mexico and fairly profitable. It is not the equal of that grown in the United States either in quantity per acre or quality. Para and Bermuda grass give pasturage in many sections of the country. They are said to be equal to any in the world.

Parts of the country are adapted to the growth of tropical products, viz., coffee, vanilla, rubber, cocoanut, cocoa, etc., the quality of all being first class. It is said the best vanilla in the world comes from the State of Veracruz and the best cocoa from the State of Chiapas. The coffee of Michoacan is said to be equal to any; the tobacco of Veracruz is preferred by many to that of Havana, and the sugar production of southern Tamaulipas or northern Veracruz is said to be surpassed by that of no country save Hawaii in quantity, and it is more profitable to the producers, for the reason that seven to ten crops are the result of one planting, whereas the Hawaiian planters get only two.

Taken as a whole, farming in Mexico is an inviting field for persons of capital and intelligence.

Railway Concession in Mexico.—Consul Griffith, of Matamoros, on June 3, 1899, says:

I have to inform the department that one of the local capitalists who has just arrived from the city of Mexico brings reliable information to the effect that the Campaña Sautena has been granted, by the Mexican government, a concession to build a branch railroad from Matamoros, in the State of Tamaulipas, to Monte Morelos, connecting there with the Mexican Gulf Railroad. Eight thousand dollars is the subsidy which the concession carries, and a further assurance that the company has $3,000,000 in cash will render the proposed construction easy. The leading citizens here entertain the utmost confidence in this project, and feel greatly encouraged by the news that the concession and subsidy are already secured. Inasmuch as President Diaz two years ago declared that no more concessions for railroads would be granted by the Mexican government, unless positive assurance were given of the ability and intention of the company seeking such concession to construct the railroad, one may conclude that the near future will witness the commencement of the development on a large scale of the varied agricultural and mineral resources of the State of Tamaulipas.

Russian Hogs in Germany.—The importation of Russian hogs into Germany is only permitted in the following places in Silesia: Beuthen, Kattowitz, Myslowitz, and Tarnowitz. Consul Erdman, of Breslau, under date of May 13, 1899, reports the number of Russian hogs imported through these border towns as 5,002, the duty being $1.19 per head. Of the total imported, 40 were rejected as being measly and one as being affected with trichinæ. These were destroyed, in accordance with law.

United States Trade with Mauritius.—Consul Campbell writes from Port Louis, May 13, 1899, that American commerce has contributed largely to the customs duties of the colony for the quarter ended March 31, 1899. The customs receipts for the first three months of 1898 amounted to 170,000 rupees ($52,700, taking the market value of the rupee at 31 cents), and during the same period of this year to 300,000 rupees ($93,000). United States trade with the island has contributed to the above the amount of 87,206 rupees ($27,033) in export duties alone.

Spanish Tariff on Flour.—Consul Sprague, of Gibraltar, on June 21, 1899, writes that there is a differential duty of 2 pesetas* for every 100 kilogrammes (220 pounds) between United States and British flour entering Spain, to the prejudice of the former. The matter, he adds, is of some importance, as at present American flour can undersell other foreign importations in this line.

* Taking the valuation of the Mexican dollar, as estimated by the United States Director of the Mint, July 1, 1899, at 48·1 cents.

* The nominal value of the peseta is 19 3 cents; its market value is considerably less.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted

TRADE NOTES AND RECEIPTS.

Insulating Substance.—Same consists of ordinary glazier's putty, and the objects surrounded with it are at once sprinkled closely with powdered glass, 60 parts, cement, 15 parts, powdered stone, 25 parts. It also protects wires from moisture. The mass has been tried in practice.—Neueste Erfahrungen und Erfindungen.

Ernest Schliemann, of Hamburg, Germany, forces air through molten resin and paraffine, and obtains in this way a wax-like material which is not sticky. This preparation can be improved upon by using as oxidizing agents, not simply air, but nitric acid chromates or permanganate of potash. The chemicals cost a little more than the air, but the treatment is cheaper.

Waterproof Paper.—Coat the paper on both sides with the following solution:

Glycerin	1 part.
Glue (gelatin)	1 "
Water	4 "

Allow to dry, and draw through a solution of 10 per cent. formaldehyde (formaline).

Gelatine Tubes.—Instead of the customary tin tubes, Dr. Stohr, of Vienna, introduces tubes made of gelatine, which owing to their transparency allow of controlling the filling and are said to be indifferent to salves and soaps and cheaper than metallic tubes. For contents sensitive to light, colored gelatine tubes are employed.—Neueste Erfindungen und Erfahrungen.

Keeping Ice in Small Quantities.—To keep ice from melting, attention is called to an old preserving method. The ice is cracked with a hammer between two layers of a strong cloth. Now tie over a common unglazed flower pot holding about 1 to 2 liters and placed upon a porcelain dish, a piece of white flannel in such a manner that it is turned down funnel-like into the interior of the pot without, however, touching the bottom. Placed in this flannel funnel, the cracked ice keeps for days. —N. Erf. und Erf.

Production of Crystalline Honey Pomatum.—Nut oil, 500 grammes; spermaceti, 60 grammes; gamboge, 7½ grammes; vervain oil, 10 drops; cinnamon oil, 20 drops; bergamot oil, 30 drops; rose oil, 3 drops. The spermaceti is melted in the nut oil on a water bath and digested with the gamboge for twenty minutes, whereupon strain, scent, and pour into cans which are standing in water. The cooling must take place very slowly. Instead of gamboge, butter color may be used. Besides, any desired scent mixture may be employed.—Drogisten Zeitung.

Production of Soldering Mediums.—Soldering Paste.—A solution of sheet zinc waste in ordinary hydrochloric acid is diluted with an equal quantity of water and filtered. Next, aqueous ammonia is added, so that the precipitate is dissolved again. This zinc chloride-ammonia solution is mixed with thick starch paste, so that a sirupy mass results, which is very useful for soldering tin plate, iron, and brass.

Soldering Grease. — Melt together 5 parts of colophony and 5 parts of tallow and add 1 part of finely powdered sal ammoniac.—Neueste Erfindungen und Erfahrungen.

New Pile-driving Method.—The use of the jet of water to drive piles has been known for a long time. Of late, some Russian engineers have invented a method which renders it possible to ram down piles three or four times faster than by the old method. In this new process gaspipes lead to the other end of the pile, while gutta-percha tubes are fixed above, through which the air is driven in, at pressure of 33 kilos. This beats a path for the pile so that it can be driven down with ease. When the pile is in deep enough, the pipes are taken off and fastened to the next pile by means of clamps.—Technische Berichte.

Arc light carbon-rods are said to suffer almost no combustion at all and to give an exceedingly intense light if for their production a mass of the finest retort graphite with an addition of about 10 per cent. silicium carbide (carborundum) is employed. The carbons may, however, also be formed into hollow rods of ordinary composition, only the inner core consisting of carborundum. Since the latter preparation can be produced only with the aid of a very strong electric arc, an evaporation or oxidation with the use of cored carbon is not possible. As silicium carbide, however, does not conduct the current, an admixture of carbon is absolutely necessary.—Neueste Erf. und Erf.

Bronzing of Wood.—For the bronzing of wood diluted water glass solution is recommended, the wooden object being uniformly painted with it. Bronze powder is sprinkled on from a wide-necked glass tied up with gauze, and the excess removed by gently knocking. The bronze powder adheres so firmly after drying that a polish may be put on by means of an agate. The process is especially useful for repairing worn-off picture frames, book ornamentations, etc. For a good gold or bronze ground the following recipe is given: Boil 11 liters of linseed oil with 25 grammes of impure zinc carbonate, 100 grammes of red lead, 25 grammes of litharge and 0·3 gramme of mercuric chloride, until a drop taken out will stand like a pea upon a glass surface. Before complete cooling, the mass is diluted with oil turpentine to a thick sirup.—Bayerisches Industrie und Gewerbeblatt.

Nickel and the majority of metals subject to tarnish can be restored to their original color by the following process: Dissolve 0·40 to 0·45 gramme of cyanide of potassium in half a glass of water, plunge the objects into this solution and retire them immediately. The cyanide of potassium being very soluble in water, a simple rinsing with water suffices to remove every trace of acid. Next plunge them in spirit of wine and dry them in saw dust to preserve from rust. The spiral spring of a watch may safely be subjected to this operation. If the objects are greasy, they must be cleansed with benzine before being immersed in the cyanide, for the latter has no action on the grease. The cyanide of potassium being a violent poison, the operation must be conducted with great caution, and in a well aired room. The bath preserved in a bottle may be employed many times over again.—Moniteur de la Bijouterie et de l'Horlogerie.

MISCELLANEOUS NOTES.

The grave of a blacksmith in Belleville, Ill., is surmounted by a large anvil upon which the deceased had worked for more than a quarter century.

Mr. Beikenbusch has measured the temperature of the Bunsen flame by a new electric method. He employed a thermo couple, heating it by an electric current until it had the same temperature as the flame, and then measured the temperature of the thermo couple for the same current in a vacuum. The temperature was 1,820° Centigrade, or 3,308° Fahr.

According to Dr. Dawson Turner, writing in Nature, it is not easy to measure the electrical resistance of the blood of a living person. His best results were obtained by placing five cubic millimeters of freshly-drawn blood between two cup-shaped electrodes three millimeters in diameter, coated with spongy platinum, and fixed 0·75 mm. apart. He says that the average resistance of normal blood at 60° Fahr. measured by Kohlrausch's method is 550 ohms; but an observation which may be of great value to the physician is appended: "A striking change may be observed in pernicious anæmia, the resistance in this disease being sometimes diminished to about one-half that of normal blood." It is suggested that the blood contains an abnormal amount of salts.

A section of water pipe, 30 feet long, was taken up at Rochester, N. Y., recently, which was laid twenty-five years ago. It was a thin, riveted wrought iron pipe, one-eighth of an inch in thickness, and was laid in 1874 by Thomas Leighton as a portion of the 24-inch supply pipe from Carroll to Fitzhugh race to the Holly pumping station. The pipe was practically as good as when it was laid twenty-five years ago, and the general opinion of the experts was that if it should be replaced it would last as long again. The pipe was made for another use, but the contractor, having it on hand, used it for the above purpose. Chief Engineer Kuichling has caused photographs of the pipe to be taken and a record of the cost of the pipe, its use and its condition will be made.—Municipal Engineering.

An account of some simple experiments on the best forms of curves for use with gliding or soaring machines for artificial flight has been sent by Mr. A. A. Merrill, of the Boston Aeronautical Society, U. S. A., to Nature. A bicycle wheel was arranged to revolve in a vertical plane upon an axle fastened in a pier. From a point on the wheel a rod projected, and at the end of the rod the surface to be experimented upon was fixed at an observed angle with the plane of revolution of the wheel. The wheel was then started by the fall of a weight joined to the wheel in such a way that when the weight had fallen through a certain distance it became disconnected. After a surface had been fastened to the rod, the wheel was started, and when it had stopped, the number of revolutions it had made was shown by a mechanical recorder. Given the same starting force, the number of revolutions would evidently depend upon the facility with which the surface moved through the air. The surface which offered the least resistance to motion was thus obtained. Among other results, the experiments seem to confirm Mr. L. Hargrave's statement that the existence of a wind vortex under a bird's wing is an important factor in soaring.

In the Bulletin International of the Cracow Academy, M. P. Rudski applies the well-known problem of the elastic sphere under given surface-tractions to calculate the radial displacements of the earth's surface under the weight of ice caps. There are strong reasons for believing that during the glacial period large areas of land were submerged which at the present time are at considerable altitudes above the sea-level, and M. Rudski's object is to test whether these displacements of the shore line can be accounted for by the distortion of the earth due to circumpolar ice, assuming the total quantity of water on the earth's surface to be constant. M. Rudski considers the test case of uniform ice caps extending down to latitude 60°, and he assumes the rigidity of the earth to be the same as that of steel. The deformations are different according to whether glaciation exists about one or both poles, the depressions at the poles being respectively 347·1 and 497·8 meters for an ice cap 2,000 meters thick. Moreover, with bipolar glaciation the displacement of the shore at the edge of the ice caps is negative, while with unipolar glaciation it is positive but smaller. In either case, supposing fiords to extend inward into the ice caps, the shore displacements toward the center of the caps would be positive.

Best Strength of Acid for an Accumulator.—The question is often asked, says The American Electrician, whether or not an accumulator would be improved if the acid were stronger, and the reason that this is difficult to answer is that a difference in concentration has various effects, the choice of the best concentration being therefore by no means a simple one. Some time ago Mr. Juman found that the capacity of an accumulator varied with the concentration of the acid, but that the variation was not a constant one, as it increased at first with the concentration, then reached a maximum, and then diminished again for greater concentration, thus showing that there is a certain strength of acid for which the capacity was greatest. In order to find whether this was true for all rates of discharge, he made some very elaborate experiments, which are described in L'Eclairage Electrique, but with the unfortunate result that for different rapidities of discharge this best concentration was quite different, as it increased with the rate of discharge, and soon got above 35° Baumé, which is about the practical limit, as sulphating of the negative plate is apt to occur with greater concentrations. He also continued the investigations to find whether this best concentration was the same for the positive plates as for the negatives, and found that for the positive plates the acid should be more concentrated to give the best capacity, and for the negatives less so, but in both it varied. Theoretically, therefore, the best conditions are obtained with different concentrations of acid, which can only be had with the aid of a porous cup, and that is not practical; moreover, there is a certain density which is the best for each rate of discharge. It is, therefore, possible to give only a general rule concerning the concentration, namely, that it should be greater, the greater the rate or rapidity of discharge.

SELECTED FORMULÆ.

Weatherproof Brown Coatings for Brass.—Like other alloys rich in zinc, brass does not "brown" so well as copper, red metal, or bronze, and, for the production of "patina," should be bronzed. For artistic effect combined with durability, gold electroplating gives the best results, copper acetate and ammonium chloride or "liver of sulphur" being afterward used to produce durable toning; or the depressions may be lightly shaded with black varnish, leaving bright the portions in relief.

A very handsome brown may be produced on brass castings by immersing the thoroughly cleaned and dried articles in a warm solution of 15 parts of sodium hydrate and 5 parts of cupric carbonate in 100 parts of water. The metal turns dark yellow, light brown, and finally dark brown, with a greenish shimmer, and, when the desired shade is reached, is taken out of the bath, rinsed, and dried.

Another method is to paint the cleaned and dried surface uniformly with a dilute solution of ammonium sulphide. When this coating is dry, it is rubbed over, and then painted with a dilute ammoniacal solution of arsenic sulphide, until the required depth of color is attained. If the results are not satisfactory, the painting can be repeated after washing over with ammonia. Prolonged immersion in the second solution produces a grayish-green film, which looks well and acquires luster when polished with a cloth.—Journal Society of Chemical Industry.

Chewing Gum.—

1. Gum chicle	3½	pounds.
Paraffin wax	1	"
Balsam tolu	2	ounces.
Sugar	12	pounds.
Water	3	pints.

Flavoring, a sufficient quantity.

Method.—By the aid of heat dissolve the sugar in the water; pour the resultant sirup upon an oiled slab; add the chicle, paraffin wax, and balsam tolu all melted together, and mix thoroughly.

2. Chicle	3¾	pounds.
White wax	1	"
Sugar	10	"
Glucose	2	"
Water	3	pints.
Balsam Peru	1	ounce.

Flavoring, a sufficient quantity.

Method.—The same as that employed in No. 1.—American Druggist.

Cements and Plastic Compositions for Forming Counterpart Rollers or Plates used for Embossing Paper, Asbestos, or Similar Impressible Fabrics in Hollow Relief. —Oxidized or solidified oil, 70 pounds; kauri gum, 10 pounds; resin, 10 pounds; and litharge, 2½ pounds; are heated in a steam-jacketed pan and agitated. To render the cement more adhesive, from 2 to 5 per cent. of castor oil should be added while mixing. Of this cement, 20 pounds are compounded with 18 pounds of cork dust or wood flour, 18 pounds of asbestos or whiting, and ¼ pound of driers. The plastic composition may be made of varying degrees of hardness, by varying the proportion of gun resin and driers, and is applied hot. This forms the subject of an English patent and is reported in the Journal of the Society of Chemical Industry.

Sulphocyanide Toning Bath.—

Potassium sulphocyanide	1 oz.
Gold chloride	15 grs.
Distilled water	4 ozs.

Dissolve the sulphocyanide in half the water and the gold in the remainder; mix the two solutions.

This solution must be kept in the dark.

Every two drachms contains 1 grain of gold, and should be diluted with 8 ounces of water to make a normal bath that will tone about 340 square inches of surface.

Ball Blue.—The ball sold for laundry use consists usually, if not always, of ultramarine. The balls are formed by compression, starch or some other excipient of like character being added to render the mass cohesive. Blocks of blue can, of course, be made by the same process. The manufacturers of ultramarine prepare balls and cubes of the pigment on a large scale, and it does not seem likely that there would be a sufficient margin of profit to justify the making of them in a small way from the powdered pigment. Careful experiments, however, would be necessary to positively determine this. Ultramarine is of many qualities, and it may be expected that the balls will vary also in the amount of "filling" according to the price at which they are to be sold.

As an illustration of the "filling" or diluting process, and a suggestion for experiment, we reprint the following:

Ultramarine	6 oz.
Sodium carbonate	4 "
Glucose	1 "
Water, a sufficient quantity.	

Make a thick paste, roll into sheets, and cut into tablets.

The balls in bulk can be obtained only in large packages of the manufacturers, say barrels of 200 pounds; but put up in 1-pound boxes they can be bought in cases as small as 28 pounds.

Where there is a trade for small packages there would apparently be a fair margin of profit in buying 28-pound lots and putting them up in 1-ounce and 2-ounce cartons.

The term bag bluing simply indicates a solid blue, which, whatever its composition, is used by placing in a little bag, immersing this in water, and pressing out the liquid into the water to be blued.—Druggist's Circular.

To Protect Cattle from Flies.—The Suddeutsche Apotheker Zeitung gives the following formula for a preparation for keeping flies off cattle:

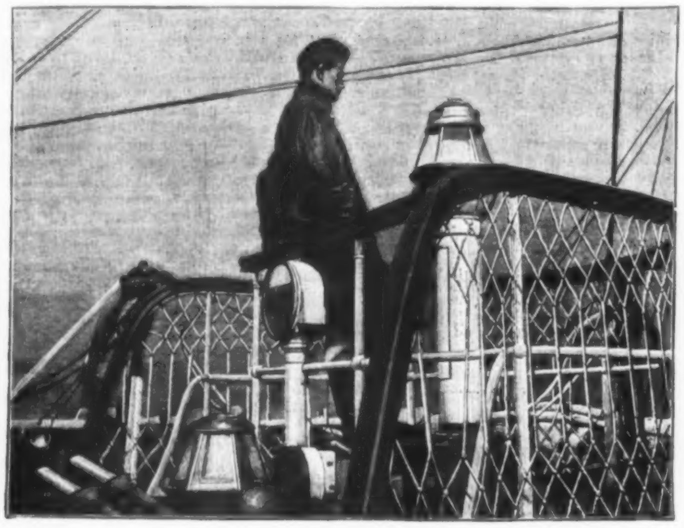
Oil of cloves	3 parts.
Oil of bay	5 "
Tincture of eucalyptus	5 "
Alcohol	150 "
Water	200 "

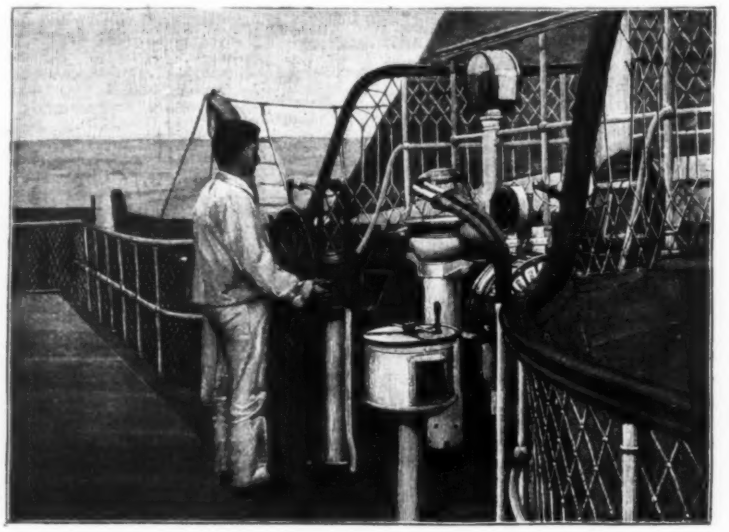
LIFE ON THE SCHOOLSHIPS OF THE GERMAN NAVY.—II.

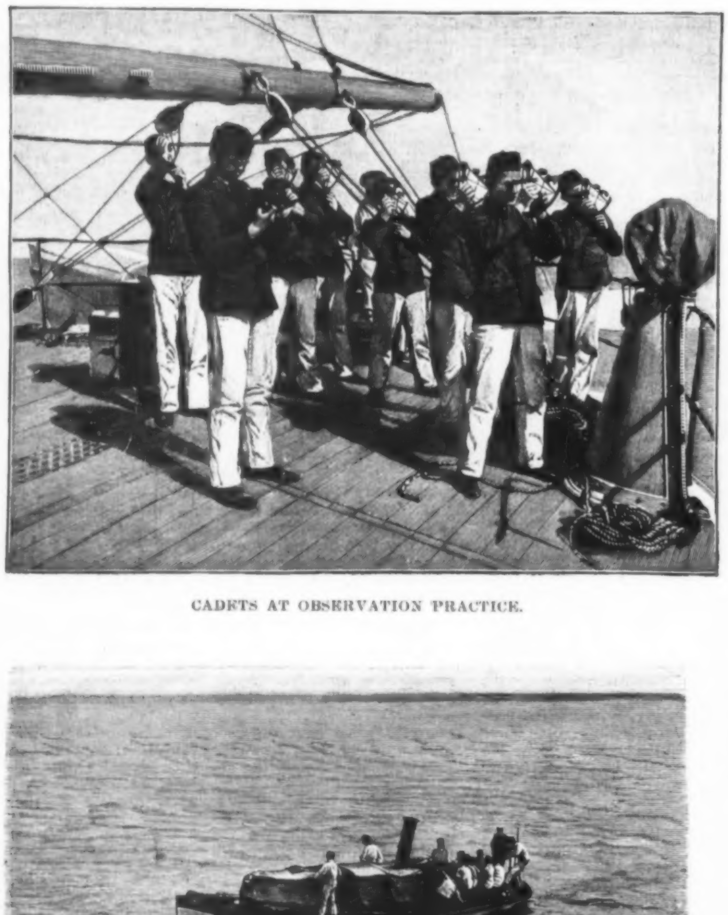
INSTRUCTION IN SEAMANSHIP.

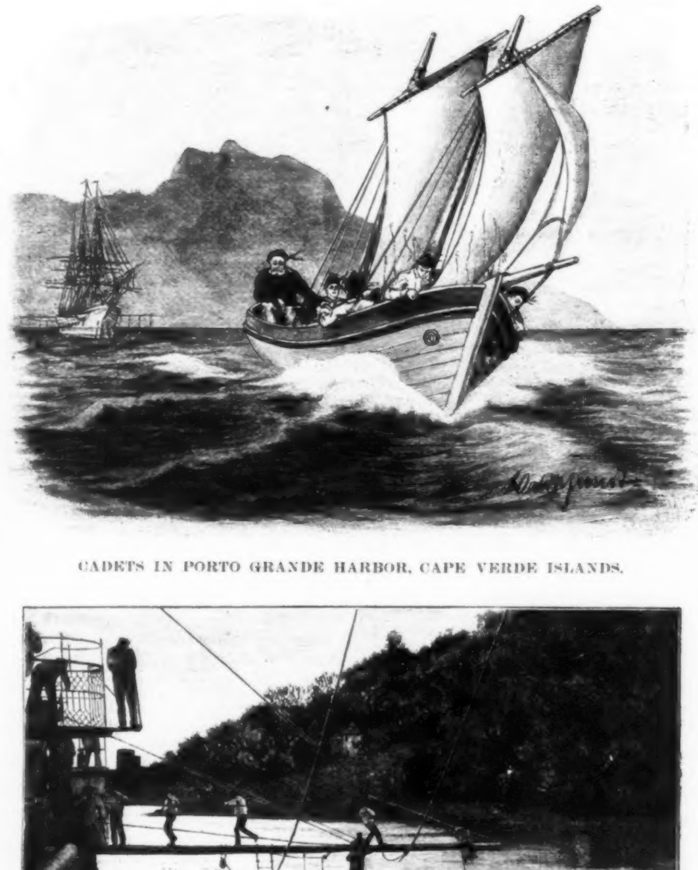
THE course in seamanship and navigation introduces the cadet to an entirely new department of his work. The regular seaman by vocation who sails under the flag of the merchant marine knows only this branch of the naval service. It is enough for him, for it enables him to take a ship from harbor to harbor and to keep it in proper condition. But an officer of the navy is a seaman and a soldier at the same time; he is specially an artilleryman, although not ignorant of the duties of an infantryman, and in order to fill his place well he must be master of a great deal of other knowledge relating to marine and military matters, which is not required of a man in the merchant marine. At the same time, seamanship must form the foundation of the knowledge and skill of the naval officer, for, besides preparing him to manage a ship under all circumstances, it trains his eye to observe so that nothing shall escape him, and his mind to form accurate judgments, and at the same time teaches him courage to act promptly under trying conditions. It also requires an intelligent use of several indispensable instruments, the best known of which is the compass. A few words in regard to this all-important instrument may not come amiss. The most important parts of the compass are the "rose"—a mica disk on which is traced a star or rose with thirty-two branches, making the eight points or rhumbs of the wind, the demi-rhumbs and the quarters—and the magnetic needle. In the common pocket compass the needle floats over the "rose," which can be turned until the point marked "N" comes under the point of the needle, but in the mariner's compass the needle carries the "rose" or star. On the inner wall of the compass box there is a perpendicular line, the steering line, which is always in the plane of the keel, or in a parallel plane, in case the compass does not stand directly over the keel, by which the direction in which the vessel is moving can be ascertained, this being indicated by the point of the rose that coincides with the steering line. For instance, if the mark indicating southwest lies opposite the steering line, the bow of the vessel is toward the southwest. The compass box is hung on gimbals, so that it always stands horizontal.

A variation compass, of the same construction, is used in taking bearings; that is, in determining the relation of the ship to an object on the sea or on land, such as a lighthouse or the top of a high mountain; and as it is necessary that it should stand where the view is unobstructed, it stands on the highest part of the bridge. Instruction in the use of this compass is given the cadet when in port, and he is also taught to note the indications of the weather, to be on the watch for the changes of wind and squalls, for the effect of the wind on the sails, and also for the peculiarities of the vessel, as shown by the way in which it responds to the sails and the rudder. The officer of the watch


CADET AT THE COMPASS.


CADET AT THE WHEEL.


CADETS AT OBSERVATION PRACTICE.


CADETS IN PORTO GRANDE HARBOR, CAPE VERDE ISLANDS.


CADETS LEARNING TO MANAGE STEAM LAUNCH.


THE OUTRIGGER.

LIFE ON THE SCHOOLSHIPS OF THE GERMAN NAVY

calls his attention to all these things, asks him questions, and sets him tasks, so he finds this not simply a breezy station exposed to wind and rain, but also a most instructive and interesting one.

The naval cadet must also take his place, under proper supervision, at the wheel, and this he likes, for it is inspiring to him to feel that the great ship, often so unmanageable in its element, must obey the slightest pressure of his hand. With the exception of a few schoolships, all the vessels of the German navy are provided with steam steering gear, and also auxiliary steering gear which is to be used in case the steam gear is out of order.

Still another instrument of great importance to the nvaigator is the sextant, by means of which he is able to tell exactly where he is on the broad expanse of the pathless ocean, provided, of course, that he has the sun, moon, or stars to help, for on these heavenly bodies his calculations are based. The compass shows him in what direction he is sailing, but how can he tell what part of the world lies in that direction unless he knows just where he is? Therefore, it will easily be understood that the sextant constitutes a most essential part of the equipment of a vessel. It is used for measuring angles, as, for instance, the angle formed by the sun, the horizon and the eye of the observer, or by two stars, or a star and the moon and the eye of the observer, and this angle gives the elevation of the sun —in case the sun is used in the observation—above the horizon, and then by further observations and comparisons of local time with the time of the Greenwich chronometer the navigator finds his longitude and from that he calculates the latitude of the vessel. The cadet is taught only the preliminary steps in the use of the sextant; he is not expected to read the instrument easily and measure angles accurately until his second year, when he is an ensign. One of our engravings shows cadets sextant in hand, making an observation.

Instruction in the handling of the ship's boats constitutes, so to speak, a sort of preparatory school for the intelligent management of steamships and sailing vessels and at the same time is very useful in itself, for ships' boats, which establish communication between the vessel and the land, are always steered by ensigns if the vessel carries ensigns. Therefore, in order that he may, in future, be able to act as helmsman on a steam launch or cutter, the cadet must learn to manage steam, sail or row boats. No small amount of dexterity and skill is required to carry out the commands that come to him through the speaking trumpet, handling the rudder and the engine so as to bring the steam launch gracefully and safely to the gangway when the sea is high, just as a coachman must understand his art to bring his fiery steeds up to the door at a brisk trot and stop them at just the right spot.

Safe and elegant sailing has its difficulties and must be thoroughly understood, for besides a knowledge of the management of the sails and the rudder, many other things must be noticed, which are learned only by practice and experience, but the cadet is taught to observe, and is given a general knowledge of what is needed in sailing a boat, and then as an ensign he receives further instruction, but much depends on his love for his work and his adaptability.

Rowing forms an important part of the cadet's training, not only that he may be able to glide safely and elegantly over the water, but also because this training strengthens and develops his body. After the rowing exercise, the boats are either hoisted to their davits on the vessel or secured to the outrigger—booms which extend over the water from the sides of the vessel for this purpose, and by means of which the men go to and return from the boats.

Seamanship also includes a knowledge of the entire ship, in all its parts from the keel to the topmast, and the use of each part, as well as a knowledge of many kinds of work to do, such as splicing ropes, making knots of various kinds, tarring the ropes, rigging and unrigging yards, etc., making blocks, and, among other things, weaving mats for use in protecting certain parts of the vessel from chafing. In all this his practical mind and technical skill aid him.

We are indebted to Ueber Land und Meer for the engraving and the information from which our article was prepared.

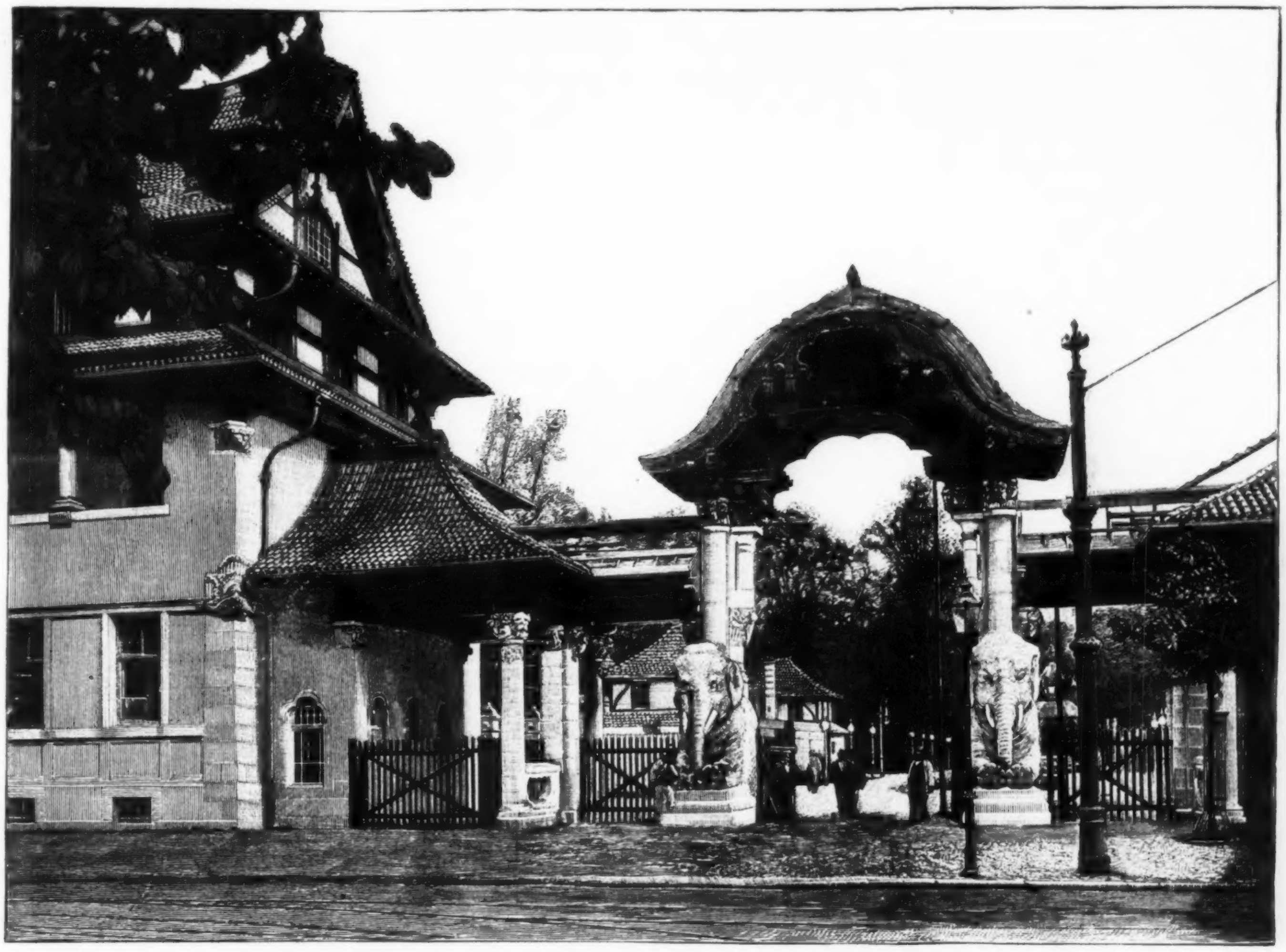
THE NEW MAIN ENTRANCE OF THE BERLIN ZOÖLOGICAL GARDENS.

As early as the seventies it was generally admitted that the Zoölogical Gardens of Berlin possessed the most unique and most magnificent buildings. Nor can it be denied that for the last ten years its mammals and collection of twelve hundred species of birds have been the finest in the world. But the general condition of the menagerie has often been criticised, perhaps not unjustly. The exterior in appearance lacked effectiveness. The two entrances later erected at the Kurfürstendamm and at the Stadtbahn (City Railway) which long served as main entrances, were not organically connected with the plan of the whole; and only the original main entrance to the menagerie was more attractive in appearance. The buildings had all been erected with a fearful regard for the protection of trees, to the detriment of the original plans; and hence originated a labyrinth of serpentine paths in a densely grown park, in which light and air were lacking as well as plant decoration.

These defects were keenly felt by the management; but a remedy could not be effected, despite the very respectable annual surplus. Thanks to the efforts of Baurath Böckmann, a new series of bonds was issued, and with the sums thus obtained, the work of renovation could be begun on a large scale. The region about the Kurfürstendamm, where the stream of daily visitors constantly flows in and out, was first attacked. Here it was that Architects Zaar and Vahl erected the gate illustrated in our engraving.

The changed countenance which the Zoölogical Gardens presents to the neighboring main arteries of traffic, the Kurfürstendamm and the Kurfürstenstrasse, were to be unusual and unique; that was one of the conditions of the prize contest instituted for the purpose of obtaining strikingly original plans. The artistic problem of preparing the visitor for the foreign atmosphere within was happily solved by a plan which bore the characteristic device: "Zum Japanischen Thor" (to the Japanese Gate). With equal felicity and care the specifications for size and arrangement of the various structures were prepared. The jury did not hesitate to award this design the prize; and the Board of Directors immediately resolved to carry out the plan.

At present the Elefantenthor (Elephant's Gate) and the Japanese Palace are almost completed. To the left of our engraving the doorkeeper's house is shown. To the right is a second box-office and a house of relief, to which a bicycle shed is annexed. All the structures have been built in the Japanese style and united into a single effective group of buildings, whose graceful lines and bright colors pleasantly greet the eye. Even in the minor features the builders have adhered to the Japanese and woven in, as it were, all possible references to the Zoölogical Gardens. In a similar manner the enlarged and improved administration buildings, workshops, hayricks, and stables have been skillfully treated in the Japanese style. At the Kurfürstendamm entrance a whole Japanese quarter has arisen which harmonizes with the adjacent bird cages and the splendid Japanese building erected a year ago. Behind the Elefantenthor begins one ray of the new three star promenade (Dreisternpromenade), which is decorated with flowerbeds. In the evening Welsbach lights in attractive globes illuminate the entrance to the Kurfürstendamm, the Concert Platz, and the Antelope House. In its center this three-rayed star contains a luminous fountain and a Japanese-Chinese music temple in blue, red, gold and copper.—Illustrirte Zeitung.



THE NEW MAIN ENTRANCE TO THE BERLIN ZOÖLOGICAL GARDENS.

ELECTRIC RAILWAY FROM MILAN TO MONZA.

It is interesting that the first Italian railway, the Milan-Monza line, eight miles long, opened in 1840, is also the first Italian line that has been converted into an electric railroad, and that accumulator traction has been adopted. The primary power comes from the turbines of the Italian Edison Company, on the Adda, near Paderno. The triphase currents of 3,600 volts are taken to a converter, whose two parts, a triphase motor and a continuous current generator, are joined by an elastic coupling. The cars, which are on the American pattern, have been built by Grondona & Company, of Milan, the accumulators were supplied by Heusemberger, of Monza, and the motors and electric apparatus by the Elektricitäs-Aktien-Gesellschaft, late Schuckert & Company, of Nuremberg. The cars have a length of 59 feet and a width of 9½ feet, and are divided into first and second class compartments, for smokers and non-smokers, with sixty-four seats and standing room. The compartments are illuminated by 10-candle lamps, and each of the platform divisions by one lamp of 16 candles. The car further carries five signal lamps of 25 candles, and is provided with hand brake, Westinghouse brake, compressed air cylinders for the whistles, and two controllers. The motors are held by two pairs of elastic spiral springs, one of which is under compression and the other under tension. Each motor drives one of the outer axles; the cylindrical toothed gearing has a reduction of 61 to 20. There are two batteries on each car suspended below the floor, so that no gases can penetrate into the interior. The large battery of 130 cells feeds the electric motors and the pump motor for the brake; the small battery supplies the lamp current. One charge suf-

fices for three double journeys; the charging, during which the cells remain on board, takes a little more than an hour. The cars weigh 58 tons each, the batteries alone 17 tons. The track is fairly level, but there is a rise of 7 in 1,000 from Milan to Monza. With two intermediate stoppages, the journey is accomplished in 20 minutes. That would correspond to an average speed of about 28 miles; the speed can be raised to 37 miles. The line was opened in February, when two cars were put into service, both together making 11 double journeys daily. It is intended to add six cars, and to introduce the same kind of accumulator service cars on the line Milan-Pavia, which has a length of 22 miles. As Monza is on the road from Milan to the Lake of Como, we suppose that the ordinary engine service has not altogether been abandoned on that line. The introduction of electric traction has the support of the Italian government.—Engineering.

POWER AT THE PARIS EXPOSITION.

By JOHN T. BRAMHALL.

THE decision of the Paris Exposition management to establish an electric power plant upon the contracted space of the Exposition grounds is disappointing to those who believe that the seat of energy of this great exposition, which shall stand as the demonstration of the world's progress in the arts and sciences at the close of the nineteenth century, should itself be a worthy exponent of the engineering skill of the age.

What, then, should the Paris power plant of 1900 be like? Certainly not fashioned after those that preceded it, for that would confess inability to make further progress. It should mark a distinct advance upon the World's Fair at Chicago.

Looking back at the three American international expositions—New York, 1853, Philadelphia, 1876, and Chicago, 1893—as well as those of London, 1851, Paris, 1867, and Vienna, 1873, it is not difficult to associate the grand productions of inventive genius with the accelerated progress in the mechanical arts which followed in the next decade. But, to consider solely the subject of power generation, the Crystal Palace in New York was ill provided in that respect. America's industries in 1856 were still of the infant character, and the greater part of the machinery was imported from English workshops. The New York Tribune's reports of the exhibition, as edited for republication by Horace Greeley, devoted a hundred times the space to agricultural machinery (and indeed there was not much else) that they gave to the steam engine. Only one of these was mentioned as a primary motor, and this was dismissed with the following description:

"The beam engine, from Providence, by Corliss & Nightingale, exhibits a new application of governor. . . . The workmanship and the ingenuity displayed in this machine are above all praise. As to its practical utility, only experience can decide."

The Paris Exposition of 1867 was not remarkable for its machinery, but was noted by Geddes as the first world's fair to show processes of industry in action. The best example of transmission of power, according to the report of the American commissioners, was a "telodynamic" (wire rope) machine from Germany, capable of transmitting 120 horse power 400 feet, and a "hydro-aero dynamic wheel" (compressed air) from Belgium, which transmitted 9 horse power 600 feet, and was thought capable, under favorable conditions, of developing 15 horse power. The prime power engines, though more numerous, did not differ materially from those of the London exhibition of 1851, except that there seems to have been, according to the report of Special Commissioner Auchinclose, a marked adoption of the American model.

In regard to the Vienna Exposition of 1873, the situation is best explained in a paper by Prof. James Hart, making comparisons with the Centennial Exposition, then about to open. Prof. Hart said:

"In the department of machinery, if no other, the Centennial ought to eclipse all its predecessors. It is in the power of our manufacturers and inventors to make a display of machinery at Philadelphia that shall throw London, Paris, and Vienna completely in the shade. This utterance is not the outpouring of enthusiastic patriotism; it is based on a careful study of the Machinery Hall at Vienna. There were more 'inventive brains' in the little section occupied by America than in all the rest of the huge Machinery Hall. By the side of our ingenious contrivances, that did their work with such economy of space and force, and with such precision, the cumbrous structures from Germany, France, and even England, seemed twenty years behind the times. In this connection America may lay claim to a unique distinction. Mr. Corliss was the only person who received a diploma of honor without being an actual exhibitor. But in truth, the entire Machinery Hall, with its appurtenances, was his exhibition, for every stationary engine at work in the building or on the grounds was in principle a Corliss engine."

Grandly did the builders of the Centennial meet the hopes of its promoters and its friends. London, Paris, and Vienna were, indeed, surpassed by the long lines of busily working machinery which stretched away along the lines on either hand, all receiving their energy from a single master engine. The Corliss 1,000 horse power giant of 1876 was, in itself, the first world's fair power plant.

But 1893, the occasion of the Columbian quadri-centennial, saw another great step taken in the dominion of mind over matter, in the great central power plant, which, from the Brobdignagian battery of boilers adjoining the Palace of Mechanic Arts and the silent cyclopean Corliss of 3,000 horse power, transmitted power and light through the agency of ponderous dynamos to every part of the capacious grounds of the Exposition. Nor was this all. Not only were there no visible wires and no shafting and belting beyond the central plant itself, but there was no visible fuel supply. The power seemed to be produced by magic. There was smoke, indeed, from the great stacks, but no coal. The fuel was pumped from the oil fields of Ohio, 200 miles distant, and automatically fed to the furnaces in Jackson Park.

And now, what of Paris in 1900? Oil or gas being unavailable as a steam producer, must she go back to the antiquated system of shoveling coal beneath the great boilers that are to supply steam for her power plant on the Seine? Must great piles of coal obstruct the Champs de Mars, and boats take cargoes of ashes at the Pont de Jena? Must huge chimneys belch forth smoke to sully the white walls of the Trocadero and smut the fine fabrics in her Palais de l'Industrie? It is to be hoped that the Queen City of the world will never consent to such a confession of weakness. What then remains?

The Schaffhausen-Frankfort experiment demonstrated the possibilities of long distance transmission of power, which was confirmed by the Niagara-New York experiment. While neither was practically satisfactory from an economic point of view, they were as scientifically successful as was the telephone at Philadelphia in 1876. It now remains for France to outdo the achievements of Germany and America in the practical transmission of power, and to proclaim to the world that France celebrates the closing of the century with a feat of engineering worthy of the event and of herself.

The problem, though new, is not a difficult one for engineers. In the coal mines of Du Nord and Pas-de-Calais, within 100 miles of Paris, are great stores of energy which modern science may transmit to Paris or to the Mediterranean, if necessary, by electricity. By establishing the power plant at the mines instead of at the Exposition itself, many economies are effected, which more than offset any increase in cost of the plant and the losses in transmission. Not only the cost of delivering coal would be saved (it is 1·8 cents a ton per mile on French railways), but the "run of the mine" being used, the first cost of fuel would be far less. At the Exposition grounds valuable space would be gained for exhibits; the handling of coal and ashes would be avoided in crowded streets and grounds; the smoke nuisance would not worry exhibitors, and the fire risk would be materially lessened. These are important features to be taken into consideration when the matter of economy is discussed.

The feasibility of conducting high potentials such a distance, or even greater, with a practical efficiency, need be no longer questioned. The Niagara electrical engineers place the economic limit nearer 500 miles than 100. As to cost of plant, the conductors would furnish the heaviest item, but the copper or aluminum should not be charged on the account as a permanent investment, since the value of the metal does not deteriorate by use. Indeed, it is not unlikely that the successful operation of the plant would encourage sufficient patronage from city consumers after the close of the Exposition to warrant its continuance and extension, and thus stand as a model to London, Chicago and other great cities in the matter of the abolition of the smoke nuisance.

Nearly three years ago the suggestion was made by the writer to the directors of the Paris Exposition of 1900 of a plan for the generation and transmission of power as thus outlined, and the proposal, coming from this country, and originating, in a sense, with the Chicago Exposition, its adoption would add to the record of London (1851), Paris (1867), and Vienna (1873) another laurel wreath for America.—Western Electrician.

ELECTRICAL PROTECTION OF SAFES AND VAULTS.*

By CLYDE J. COLEMAN.

THE title of this paper assumes that all people are not honest and implies the necessity for guarding against surreptitious entrance. No one questions the right of the provident to protection against theft.

I will first aim to justify the need for a thoroughly effective safeguard by a slight research in criminology. There is one instance on record where a steel-lined bank vault was entered from the top by first ascertaining the thickness of the steel with a very small drill, leaving a hole too small to be discernible from the inside, and then using a large drill provided with a gage, so as to drill all but through the lining, and with this a series of holes was drilled embracing a section of sufficient size to admit a person when the section was removed. This method admitted of work being done each night over quite a period of time, as the drill, held from going clear through, did not show any marks from the vault interior, and still cut the metal so effectively that all that was necessary was to pound it down with a heavy sledge in order to gain access to the vault. In another instance, where entrance was gained to a vault from the top, after the vault had been plundered a wedge was so placed that the lock and bolt work on the door could not be operated from the outside; in the morning the cashier, failing to open the vault, telegraphed for an expert, who worked for three or four days drilling before he succeeded in opening and discovered what had been done and that the vault had been robbed. This delay allowed the burglars sufficient time to successfully escape.

The use of nitro-glycerine and other high explosives has been so successful as to show the folly of trying to make something so strong that it cannot be broken. The latest danger to the banker is the electric current. While it involves a certain amount of engineering on the part of the burglar, the conditions existing, especially in large cities, are such that it is a comparatively easy matter to provide sufficient power to effect an entrance to any vault, as it will accomplish what explosives cannot, owing to the environments in the larger cities making such a method extremely risky, while the electric arc can be used quietly, quickly, and employed so as to show no light. Where current from incandescent or power circuits cannot be obtained, storage batteries are by no means out of the question, as they can, for a case of this kind, be discharged far above their rated capacity, besides being made especially light for the occasion, as they need be used but once, and all the usual considerations of local action and long life do not have to be considered. The use of the electric arc does not require the amount of intelligence so often displayed in constructing an ingenious set of burglar's tools, and as to weight these tools often weigh over 500 pounds. An interesting thing is that no insulating material interposed between vault plates seems to make any difference with the arc, as it has been found by experiment that asbestos, concrete, etc., burn as rapidly as any metal, which is due no doubt to their fusing and becoming electrolytic conductors.

The present Secretary of the United States Treasury, after investigating the subject of burning and the use of storage batteries, said he considered it entirely feasible for a burglar to rent a room adjacent to a bank and carry in as many batteries as he liked at his leisure, and offered the argument that if discovered they would not be evidence of criminal intent, as would burglar's tools. The future possibilities of new dangers are almost unlimited. It would be interesting to know what might be done with liquid air by pouring a couple of gallons on top of a safe and cooling the steel to a point where it could be easily broken with a sudden blow from a heavy hammer. Liquid oxygen might be used to burn a hole through a wall of steel by lighting a piece of sulphur and using it as a match to start the combustion of the steel and then turning in a stream of oxygen.

Now, coming directly to the subject of this paper, it might be well to divide electric protective systems broadly into open and closed circuit systems. The open circuit system, as its title implies, depends for its operation upon contacts or equivalent devices, closing a circuit to operate some alarm mechanism, when an unwarranted entrance is attempted. This system is little used, except in residences, and then it has proved really more of a nuisance than an advantage.

The closed circuit system comprehends the use of a current of given strength, continuously traversing the line wire connecting the vaults or premises with the alarm station, together with contacts, circuits, linings, resistance coils, etc., and connected with a relay at the alarm station, which is so adjusted that this normal amount of current keeps the instrument balanced. Should the current be increased or decreased, which would be the case were any part of the circuit broken or short-circuited, the balance on the relay would be disturbed in such a way as to give an alarm by closing a local circuit connected with and controlling the alarm mechanism. But it has been found that a system of this kind is capable of being circumvented. By interpolating a low resistance milamperemeter in the circuit and employing two sets of variable resistances, so that by gradually cutting in resistance on the alarm circuit and cutting out resistance across the alarm circuit, and by observing the milamperemeter, so as to maintain at all times the current constant on the alarm station end of the circuit, it is possible to finally shift the current from the protected structure to the artificial resistance, so that the circuits at the vault or guarded premises are rendered inoperative.

To overcome this difficulty and thoroughly protect the line wires (which are the most vulnerable part of an alarm system) a number of schemes have been proposed, such as having frequent predetermined signals, changes of resistance, voltage, etc., sent to the alarm station by a watchman or some automatic device. Then, again, this must be so arranged as not to allow of its cycle of operations being ascertained by any outside means; it should also be capable of automatic operation at both ends; otherwise, it will involve so much constant manual attention at the alarm station as to be impractical. One very effective and simple method is to construct the line wire of a number of very fine and thinly insulated wires and braid the whole into a cable. By connecting each wire to the system the cable will present a veritable labyrinth of circuits so closely interwoven that it is physically impossible to do anything with it. Another method proposed is the use of wireless telegraphy, thereby dispensing with any wires to tamper with.

Instead of the usual alarm station, involving manual attention and consequently susceptible of collusion, a system much more practical for banks is one in which a large alarm mechanism is placed in a heavily constructed steel box, which, in turn, is electrically protected, so it cannot be tampered with, and is located in some conspicuous place on the bank premises. A system of this character must possess the advantage of being automatic in its operation and entirely under the control of the banker from the vault end.

ELECTRICAL BARRIERS.

One of the most exacting conditions relative to this branch of electrical engineering is to obtain a satisfactory protective means for the vault or guarded premises. Probably the simplest and most efficient window protection consists simply in cementing narrow tinfoil strips on the inner surface of the glass, as any breakage or fracture of the glass will suffice to open the circuit.

For guarding entrances or the walls of rooms, glass tubes filled with mercury and connected in circuit or tubes filled with water or compressed air, or conversely maintaining a vacuum in a partition or inclosure, have all been used, so that any disturbance from a normal condition will result in an alarm being given.

A very difficult barrier to circumvent is one in which steel wires are tensioned by a spring and adapted to a contact, so that any increase or diminution in its tension will allow a contact arm to touch a contact point located on either side of it, which is connected to the opposite side of the system, constituting practically a mechanical relay. A Frenchman proposes, by a burglar stepping on a mat, to automatically light a flashlight and open a shutter in a camera concealed in the ceiling and focused on the vault entrance, to obtain a photograph of the invaders. A rather ingenious and quite effective scheme contemplates balancing the safe on a scale platform, which is so connected to the alarm system that any weight added to or taken from it will cause an alarm. The Bank of France lowers its vaults each night in a pit filled with water, which connects with float devices, so in case it should be drained an alarm would be given.

One inventor does not propose to make any noise at all, and does not believe in letting a single burglar get away; to this end he constructs around the entrance of the vault a divided steel caging, each section of which is held open, against the pressure of a very strong spring, so arranged that any attempt to enter the vault will result in capture. Microphones have been located inside the vault and connected with a system and so adjusted that the noise attendant upon forcible entry or such as persons moving about in the interior of the vault would cause sufficient disturbance

* Read before the Chicago Electrical Association, May 5, 1899.

of the controlling current to actuate the alarm. It has also been proposed to connect the system with a transmitter at the alarm station, or at the banker's residence, so he may listen for any unusual noise should the alarm indicate a disturbance in the circuit.

The construction found to best fulfill all requirements in modern practice is an electrical lining covering the entire inner surface of the vault, which is constructed of a number of tinfoil strips cemented on insulating paper and composed of several layers of such sheets, and placed between steel plates to afford mechanical protection against injury, also to render it absolutely impossible by any means to remove such mechanical armor without destroying or disturbing so delicate a condition as the linings, while at the same time there are no moving parts to get out of order or give trouble, and if substantially installed, is permanent for any length of time.

In conclusion I will say that a modern protective system should be sensitive to the conditions it is intended to guard against, while not involving such delicacy as to give trouble, and should, so far as possible, be automatic in its operations and incapable of defeat by an expert conversant with all conditions, even to the minutest details.

The time belongs to the past when custodians of funds may place safe dependence upon mechanical safeguards, solely to resist physical force. They must provide such safeguards with something that will give notice of any attempt to attack, and in electricity is to be found the secret slave and silent sentinel that is the omnipotent and omnipresent guardian.

TAXATION IN CHINA—RATES IMPOSED AND METHOD OF COLLECTION.

ONE obstacle to the industrial and commercial progress of China is the irregular system of taxation which prevails. Aside from the import and export duties collected by the imperial maritime customs under the administration of Sir Robert Hart and his European and American assistants, there are other duties levied on nearly all goods, native or foreign, and levied repeatedly on the same goods, whether carried inland from the seaports or from the interior to the coast, or even from one town or city to another. These are the likin and octroi dues, which at present are exciting so much discussion. Every eight or ten miles along the principal waterways or caravan routes a likin station is found, where a tax is levied upon some article or articles carried through by boat, pack animal, or wheelbarrow. At some points every article is taxed. This is the usual rule at the gates of cities. In some cases the tax is as little as 2 per cent. ad valorem ; in others, such as silk, satin, and native opium, much more, amounting at times to 6, 8, or even 10 per cent. Between Shanghai and Soochow, a distance of eighty-four miles, there are eight likin stations. At the first and last stations all goods are dutiable ; at the rest all goods must be examined, and there is scarcely a single article that does not in that distance pay at least three taxes. It is easily seen that under such a system foreign goods cannot be carried very far from the coast before their prices become prohibitive for ordinary people.

By article 28 of the Tientsin treaty of 1858 it was proposed to substitute for these likin dues a fixed tax of 2½ per cent. ad valorem, payable at the ports where imports were landed or at the first barrier passed by exports in their outward journey, a certificate being granted to exempt the goods of any further charges. This provision has found but limited employment. Transit passes, except on certain main lines of traffic, did not protect the merchant against the exactions which long custom had sanctioned. Local and provincial authorities depended upon these collections for their support, and no provision seems to have been made to compensate them for their losses by appropriations from the imperial treasury. The question has come to the front again in connection with the proposed revision of treaties. Since the war with Japan, China is burdened with a public debt amounting now to about $200,000,000 gold. To meet the annual interest and other expenses connected with this debt the sum of $12,000,000 per annum will be needed. For such a large empire as China these sums seem insignificant, but at present China's revenue, aside from likin dues, amounts to about 56,000,000 taels ($44,000,000), viz. :

	Taels.
Customs	21,000,000
Land tax	25,000,000
Salt gabelle	10,000,000
Total	56,000,000

The customs revenue is pledged to the debt ; but when the interest on the debt and the expenses of maintaining the customs service are deducted there remains from this source not more than 3,000,000 taels for the imperial government. This leaves some 38,000,000 taels ($30,400,000) for the whole imperial administration, and it is quite evident that such a sum is altogether insufficient. It has been suggested that the customs duties should be increased, and the request does not seem unreasonable ; but there is a strong feeling among foreign merchants, our own among them, that this increase should not be agreed to unless some definite arrangement be made for the abolition of likin. At the same time it has been proposed to levy an extra tax on the products of all steam cotton mills and silk filatures, and this has called out a protest from the various chambers of commerce in China. A special committee of the Shanghai chamber has recently formulated its views on the subject. It is set forth that these mills are built under the provisions of the Shimonoseki treaty, which guaranteed them freedom from taxation ; that the protocol of October 19, permitting the Chinese government to tax the product of these mills, was, in effect, an abrogation of one of the principal articles of the Shimonoseki treaty, and unfair to those who had acted in good faith upon the assurances therein given.

The Japanese government, it is believed, found that untaxed mills in China would ruin existing industries of a similar character in Japan, and were quite willing to withdraw from the position taken at Shimonoseki, and gave their nationals due notice beforehand, so that the proposed Japanese mills at Shanghai were abandoned. The Shanghai chamber pleads that an industry of such manifest benefit to China as cotton manufacturing should be fostered by freedom from taxation. If this be impossible, the tax levied should not exceed the duty on imported yarn less the transit tax on the cotton used in the yarns to be manufactured at these mills, viz., import duty on three piculs yarn, 2·10 taels ($1.68) ; less transit duty on three piculs forty catties cotton, 0·60 taels (48 cents), or 5 mace per picul. The point emphasized is that as imported yarns pay duty only as yarns and not as cotton, so the native yarns should not be compelled to pay duty both as cotton and as yarns. It is also asked that on payment of this duty the goods shall have the same privileges as imported yarns, and on payment of a further half duty be freed from all further exactions when sent inland. Similarly, raw cotton bought in the interior for the mills is to be treated as if an export and freed by one payment from all further likin ; and it is suggested that this payment should go to the provincial authorities.

All cotton, whether native or foreign, imported to these mills, it is urged, should be admitted free of duty, or if the duty be paid, it should afterward be deducted on payment of full excise.

It is pointed out that in India and America, China's competitors in cotton raising, cotton is not taxed ; and that in India and Japan, China's nearest competitors in cotton manufacturing, the product of cotton mills is not taxed. The inference is that to levy heavy taxes on the raw cotton and the manufactured product would make the industry unprofitable.

The governor of Chekiang recently proposed to levy a tax on seed cotton of 0·40 cent per bale = 2·65 taels on a bale of yarn. The proposal of certain members of the Tsung-li Yamên was that a tax of 10 per cent. should be levied on the product of the mills. This would raise the tax on local yarns to 8·05 taels as against 2·10 taels on imported yarns, much to the advantage, therefore, of the foreign article. As Shanghai yarns at present are not taxed at all, the schedule proposed by the chamber would no doubt add a considerable amount to the revenue of the government, while its moderate character would greatly stimulate the industry, and thus in the end the treasury would gain more than by a heavier tax.—From a Report by the United States Consul-General in China ; Commercial Relations, 1896.

ROMAN GIFTS FOR HEALTH A THOUSAND YEARS AGO.

FOR centuries before the science of medicine was practiced as an art, the custom of making offerings to the gods, both as tokens of gratitude for restoration to health, as well as an inducement or bribe to the deity to grant some special favor, such as the curing of a disease or affected limb, was found among the ancients. The temples of the gods in early Greece, and in Italy also, were at that time the centers of the healing art, and each was presided over by some wise philosopher believed by the people, himself, to be immortal, existing on earth as a divine instrument to carry out an omnipotent will. At these temples gathered also the students, who sat at the feet of the wise men and imbibed their teaching and precepts.

Many of the temples were fine and imposing structures with richly decorated interiors, while others were more simple in style and usually built at the source of some hot spring or mineral water, the use of which formed the chief treatment of those who came to be healed. The water was employed both for drinking and bathing, its use being regulated and prescribed by the priests and attendants.

It was customary for each patient, however poor, to bring some gift as a votive offering, called by the Romans donaria, a practice which exists among the Italian peasantry in some districts at the present time. These offerings took a variety of forms, according to the position and wealth of the patient. The wealthy presented land, buildings, jewelry, or vessels of gold and silver. Others would add embellishments to the temple in the form of paintings, sculptures, or other decoration. The less prosperous votaries brought cattle, fruit, tools of trade, or even left their cast-off clothes as propitiatory gifts.

While some made their offerings to the deities in general, others confined their gifts to some particular divinity, and thus the temple of Artemis Brauronia was filled with women's clothing.

In the neighborhood of other temples have been found weapons, surgical instruments, tablets painted with representations of miraculous healings and enormous numbers of models of various parts of the human frame, composed of metal, stone, clay, and terra cotta. The latter are especially interesting, as they illustrate many of the diseases from which humanity suffered at that time.

These offerings were made by the patient throwing the article into the healing well or bath, or, where possible, hanging it on the walls of the temple, or round the statues of the various gods. In the temple of Æsculapius, in Greece, the names of the diseases from which the patients suffered, and their cures, were registered on tablets of marble.

The valuable offerings—many magnificent cups and vases of gold with votive inscriptions have been discovered—were well taken care of by the priests, who, it is said, melted them down after a time according to the regulations of the particular temple. The donaria of less value, when they had become too numerous, were placed in large boxes or simply buried in deep furrows in the earth, from which they are still occasionally brought to light. A peculiarity of these offerings was that their character was usually determined by the complaint from which the giver suffered. Thus, we find that certain surgical instruments were offered as a thanksgiving for a successful operation. It is recorded that Erostratus offered a forceps of lead to Apollo, in the Temple of Delphus, to show his disapproval of this method of extraction in place of the fingers.

In most of the museums in Italy, especially in the National Museum at Rome, and in several interesting private collections, many specimens of these curious native offerings may be found. Drs. Allaire and Sambon and Mr. E. Toulonze have made many interesting discoveries among donaria which throw a considerable light on many of the diseases prevalent at that early period, and on this subject Dr. Sambon has given a very complete description, to which we are indebted for many particulars. He states, among the many surgical instruments and appliances found in all parts of the Roman Empire, more than a hundred different ones are known which are certainly not inferior to those of the present day.

The old Roman instruments were composed entirely of metal, mostly bronze and iron, some being beautifully shaped and richly inlaid with silver.

Pottery in immense quantities has been found in the neighborhood of these temples, but it is usually of a fragmentary kind, but among it there are cups and vessels of every form and description, and from these a certain idea may be gathered of the epoch at which the shrine was frequented. Many of the cups are pierced with a hole, by means of which they are hung up as a votive offering after being used. Among other articles invalids' medicine cups and infants' feeding bottles have been found. The latter are both curious and interesting, and most ingeniously constructed. They were made on the plan of what is now known as the pocket ink bottle, and no flies or dust could reach their contents. The milk was introduced by inverting the bottle and pouring it through an open tube ascending within from the middle of the base almost to the apex, which also prevented its escape, except through the mouthpiece. This was in the form of a small spout emerging from one side, while opposite to it was a small handle for holding the bottle.

Several of the bottles found were fashioned in the shape of the human breast, and others take the form of various animals. They are usually discovered in the tombs of children, together with a tiny rattle, having doubtless been placed there by the mothers at the time of burial, a custom which has prevailed from time immemorial in some parts of Italy.

Another class of donaria are those representing the limbs and organs of the human body, or models of the diseased parts of the patient. These are often beautifully modeled in clay, and were presented as offerings to the healing gods by the sufferer. The most common variety are heads of every size and epoch. Some represent youth, others bearded men, while a large number are those of females. Occasionally the whole head is represented, but sometimes only one side of it is shown, the reverse being a flat surface. From the style of hairdressing represented, a good idea may be formed as to the period and locality to which they belong, the ages, according to the authorities, varying from the fifth century B. C. to the second A. D.

Models of eyes and ears are also very common, while the internal organs, such as the heart with its auricles, the kidneys, the larynx, the pelvis, and many others are frequently found. Arms, legs, hands, feet, and sometimes single fingers have also been discovered. The hands are generally represented in the attitude of worship, while the feet are usually clad in sandals, the sole being shaped in the clay and the straps painted.

These terra cotta models were made in large quantities by the wayside potters, and sold for a trifling sum to the votaries on the road to temples. The most perfect images of bronze usually consisted of figures of gods, patients offering gifts, etc. They vary in size from two or three to twenty inches, and were sometimes fixed by means of lead to small bases of marble, which bore votive inscriptions. In Dr. Sambon's collection is a model of the scalp with neatly plaited hair, and was probably a votive offering to Minerva Medica for recovery from loss of hair. Among other bronze models those of leeches have also been found.

Votive tablets of wood painted with representations of the gods or the donors were often hung on the walls or suspended from the trees in the neighborhood of the shrine and called oscilla. This curious custom of offering models in wax, wood, and silver still survives in Italy, and in many of the country churches and the small shrines in the street it is a common practice to present these gifts on recovery from sickness.

Sir William Hamilton, in a description of the Feast of S. S. Cosmo and Damian in Isernia, near Naples, he wrote in 1780, states :

"In Isernia, at the annual fair, which is held on September 27, images of wax, representing different parts of the body, are publicly offered for sale. The devout distributers of these votive offerings carry a basketful of them in one hand, and hold a plate in the other to receive the money, crying aloud, 'S. S. Cosmo Damiano.' If you ask the price of one, the answer is, 'The more you give, the more's the merit.' In the vestibule are two tables, at each of which one of the canons of the church presides, crying out, 'Here masses and litanies are received,' and the other, 'Here the votive offerings are received.' On each table is a large basin for the reception of the different offerings, which are chiefly presented by the female sex."

At the great altar in the church another of its canons attends to give the holy unction with the oil of St. Cosmo. Those who have an infirmity present themselves at the great altar and uncover the member affected, which the priest anoints.

The ancient temples must have presented a strange spectacle indeed, crowded as they were with these donaria, which hung from the walls, ceilings, and round the figures of the gods, representing the helplessness of suffering humanity and divine mercy.—Br. and Col. Dr.

The purification of acetylene is effected in Dr. Ullmann's process by means of an acidified solution of chromic acid. Dr. Wachs, of Carlsruhe, has been experimenting with the process. Two glass towers, 40 cm. in height, were packed with broken pumice saturated with a solution of crystallized chromic acid in twice its weight of 50 per cent. acetic acid and the solution also stood 2 cm. above the inlets to the towers. Acetylene containing 0·5066 gr. of phosphorus per cubic meter was passed through these towers, and then through a smaller tower packed with lime and sawdust, which retained any acetic acid sprayed over from the large towers. The gas thus purified was found to be free from phosphorus, and to have only a faint garlic-like odor, when the rate of passage was 29 liters per hour ; but at the rate of 119 liters per hour, which was considerably greater than the prescribed rate for the towers used, a small amount of phosphorus was detected in the issuing gas. The illuminating power of the gas was observed before and after purification, and was found to be virtually the same.—The Engineer.

VARIATIONS IN HUMAN GAIT.*

By E. H. BRADFORD, M.D.

IT is important in the recognition of certain diseases to examine carefully the gait of the individual, and for this purpose a knowledge of all varieties of normal human gait is useful; it is therefore somewhat surprising that the subject is one to which comparatively little attention has been given. To walk is as natural as to talk, and to walk correctly would seem to be instinctive; but grammatical speech is not instinctive, and training can improve "form" in every exercise. When Molière's uneducated bourgeois first learned that he had been talking prose all his life, his surprise showed his unacquaintance with the subject. Perhaps attempts to classify the art of walking may excite the same amused attention.

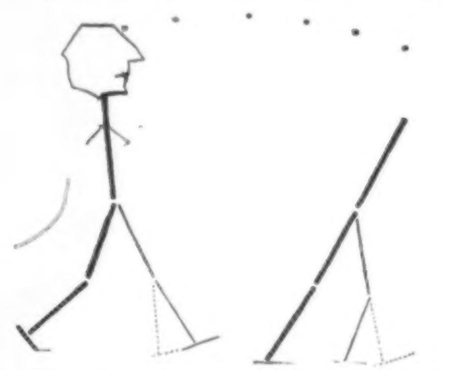


FIG. 1.—Diagram illustrating the erect and inclined gait. Dotted lines indicate the position of the leg in the variations; the upper dotted line indicates the rise and fall of the head at different portions of the gait.

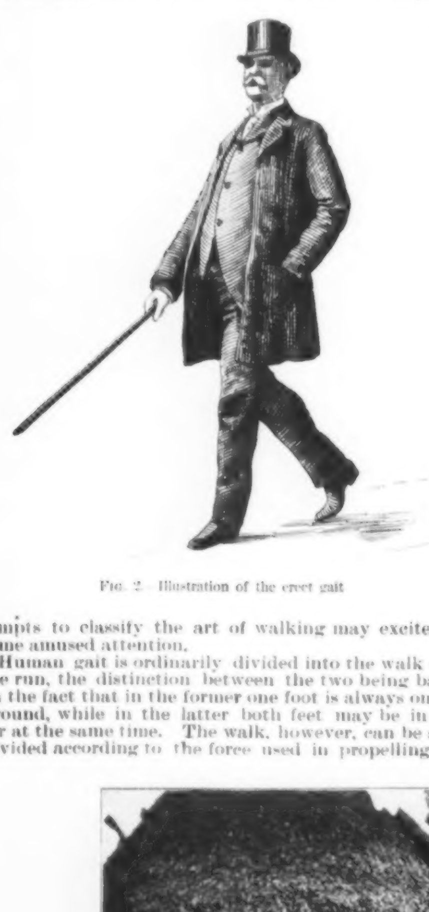


FIG. 2.—Illustration of the erect gait

Human gait is ordinarily divided into the walk and the run, the distinction between the two being based on the fact that in the former one foot is always on the ground, while in the latter both feet may be in the air at the same time. The walk, however, can be subdivided according to the force used in propelling the trunk forward, and the manner in which that force is used.

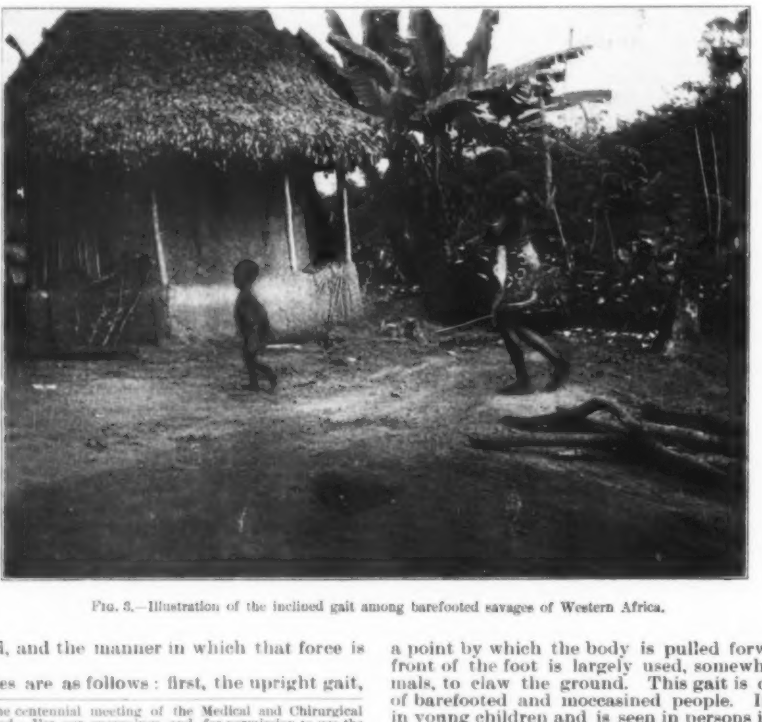


FIG. 3.—Illustration of the inclined gait among barefooted savages of Western Africa.

The varieties are as follows: first, the upright gait, which is commonly seen in adults walking on an even surface. It is characterized by the erect position of the trunk and the firm planting of the heel of the forward leg upon the ground. The trunk is pulled forward by the muscular action of the glutei and the hamstring muscles, and this is aided by the push of the rear foot. This gait is seen in all cities and is common among shoe-wearing people. It is exaggerated in people the muscles of whose feet are weakened by shoes, and by a life of leisure. In this gait, the front of the forward foot is used but little and of the rear foot only at the end of the stride. The gait consequently taxes the muscles of the soles of the feet governing the action of the toes and the front of the feet but slightly. This gait can be easily recognized by the erect position of the trunk, with the head well behind the striking point of the front heel. In exaggerated cases there is added to this an exaggerated toeing out of the feet and an unusual angle of the foot formed with the plane of the ground as the heel strikes the ground. The erect gait is common in corpulent persons and in persons walking down an incline.

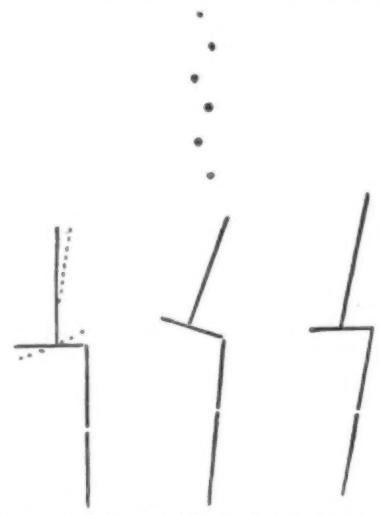


FIG. 4.—Diagram indicating the side inclination of the trunk in the variations in gait, according to the varying strength of muscular groups; dotted line indicating the line of side oscillation in the sway of the body.

The second form of gait is usually seen in barefooted individuals, and is characterized by the utilization of the weight of the body falling forward as a means of propulsion. The body is inclined forward from a stationary point, and would fall forward if this was not checked by the forward leg thrust out to prevent the fall. The heel of the front foot may or may not strike the ground first, but if it does, it is immediately followed by the whole of the sole and the toes. Ordinarily, however, the front foot catches the weight on the whole sole. The front of the foot pressing upon the ground presses the inclined body forward, and in barefooted or moccasined individuals and on soft ground, the pressure of the toes pulls the body forward, progression being also aided by the push of the rear foot at the end of the stride. The heel is but little used as a point by which the body is pulled forward, but the front of the foot is largely used, somewhat as in animals, to claw the ground. This gait is characteristic of barefooted and moccasined people. It is common in young children and is seen in persons in snow-shoeing, walking in slippery places and up a sharp ascent, and against a strong wind. The knees are usually silghtly bent, and strain comes upon certain muscles of the leg not used in the other variety of gait, that is in the muscles of the soles of the feet and the front of the thighs. Less strain comes upon the muscles of the calf, as the weight of the body is not rested on the feet, but chiefly upon the knees. As the heel does not strike the ground with a straight limb there is less jar on the spine, and as the body falling forward is utilized as an aid to propulsion there is a muscular economy in this gait.

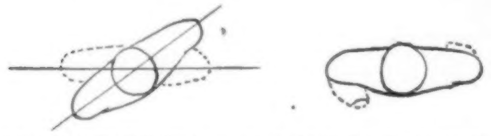


FIG. 5.—Diagram indicating the rotation of the trunk in walking, and the swing of the arm.

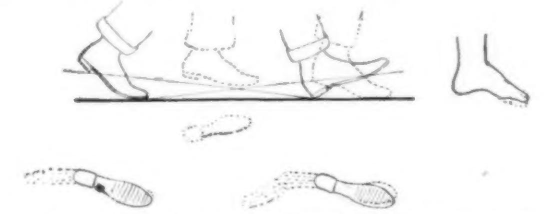


FIG. 6.—Diagram of the varying positions of the feet in different portions of the gait, and of foot impressions in walking in the snow.

A combination of these two gaits is seen in strong and active walking, the weight of the falling body being utilized, but the stride is long, a strong push of the rear leg being used.

Variations in the details of gait are seen in the angle with which the front foot strikes the ground, the straight or bent position of the forward and rear leg at the extreme limits of the stride, the angle of divergence of the foot, that is, the angle formed by the axes of the feet seen from the front or from behind, the height to which the rear foot is raised as it leaves the ground, the straight or inclined axis of the rear and front foot with the vertical plane, and the divergence and inclination of the foot as it is swung forward. These variations, when slight, are of but little practical significance, caused as they are ordinarily by habit and by the different strength of different individuals. It may be stated that the stronger the foot and the stronger the gait, the less the angle of divergence and the more near to the central line and horizontal plane the foot moves. Variations are also to be seen in the sway of the body, the swing of the arms, the rise and fall of the trunk, and the rotation of the axes of the pelvis and the thorax. These slight variations may in paralytics become exaggerated, indicating the weakness of certain muscles and causing a limp, dragging of the foot, swaying of the trunk, or unusual position of the feet. The toeing out of the feet either in standing or in walking is a conventionality if carried beyond a slight degree. Persons with normal strength of the muscles of the leg and feet can stand with the feet straight as steadily as with a slight divergence of the axis of the foot, but in shoe-wearing people in whom the action of the front of the foot is weakened, a slight amount of toeing out broadens the base of support and is of use to prevent swaying of the body; and in leisurely gait in which the muscles are relaxed and those of the foot are not much used, a slight amount of divergence of the feet is normally seen even among barefooted people, as, owing to the attachment of the psoas and iliacus muscles to the inner side of the femur, when the thigh is swung forward it would turn out slightly. This is checked and corrected in a strong gait in which the muscles of the front of the foot are actively and firmly used.

FIG. 7.—Photograph of footprints in snow.

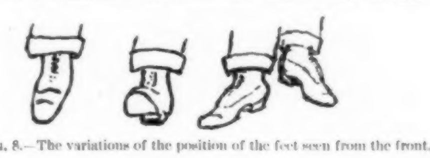


FIG. 8.—The variations of the position of the feet seen from the front.

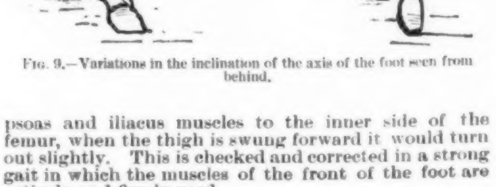


FIG. 9.—Variations in the inclination of the axis of the foot seen from behind.

* Read before the centennial meeting of the Medical and Chirurgical Faculty of Maryland.—For our engravings and for permission to use the same we are indebted to The Medical Record, of New York.

In order to detect pathological changes in the muscles of the feet and legs, it is necessary to study more closely the motions of the feet in walking. When the front foot strikes the ground in the ordinary erect gait, the heel strikes first; as the body comes forward the front of the foot strikes and remains in contact with the ground till by the forward motion of the trunk and other limb the front foot has become the rear foot; the heel is raised in the final push, and the rear foot is swung forward. The foot is swung forward clearing the ground, moving with the heel on a descending line until it strikes the ground, the toe or front of the foot being raised as the foot is pushed forward. In some individuals the heel is first raised quite high in the final push of the rear foot, in others is raised but little, and the front of the foot by a motion at the ankle-joint is raised considerably. In the latter instance considerable strength of the muscles of the front of the leg is indicated. A singular change in the direction of the foot takes place as it is swung forward. When it is raised from the ground as the rear foot, the axis of the foot may be vertical to the ground or at a varying angle, the heel dropping slightly inward, as the foot is brought forward the toe is raised and the whole limb turned slightly outward by the action of the psoas and iliacus already mentioned, so that just before the heel strikes the ground the foot turns outward more than when the heel is first raised from the ground. As the front of the foot is brought down upon the ground it is more nearly straight than when swung forward. In persons with but little play in the mediotarsal articulation, or in whom the muscles of the leg and foot are weak, the foot is but little turned in after the heel strikes the ground, producing a flat-footed gait. Under these circumstances in aggravated cases the final push at the end of the stride is weak and a shuffling gate results. In strong-muscled people, especially when barefooted, there is but little outward swing of the foot as it is brought forward and often slight toeing-in of the front of the foot as it strikes the ground; the greater toe spreads to the inside in order to grasp the ground as an aid in propulsion characteristic of barefooted or moccasined people. The swing of the foot of shoe-wearing people can best be seen in watching the tracks of individuals who have walked in freshly fallen snow, where the snowfall is not so deep as to give the gait the act of wading. It will be seen that as the foot is brought forward, the heel descends on an incline until it strikes the ground, causing a track by disturbing the snow which appears attached to the footprint. This track in the snow is always in the direction in which the individual is going and forms an angle with the axis of the footprint of the foot, the amount of the angle being dependent upon the amount the individual toes out. Light snow with a depth of a fall of two inches will in certain instances show the track of the toes of the foot as it is swung forward. This is seen somewhat to the outside of the line of descent of the heel and behind it, and will be noticed as a curved line joining the line of the descending heel. This will not be seen in strong or vigorous walking, in which the feet are brought forward in a straight direction and without an outward swing.

The old writers have claimed that in the normal gait the front of the foot strikes the ground at the same time that the heel does, and this is taught as the parade step in some armies. The fallacy of this has been completely proved by instantaneous potographs, and the step is unserviceable in the erect gait where the heel is meant to strike the ground as a point by which the body is to be pulled. It is, however, characteristic of strong walkers that the front of the foot strikes the ground after as short an interval as possible following the impact of the heel, in order that the pressure of the front foot upon the ground may be as strongly used as possible in the muscular effort of propulsion. It is for that reason that the striking of the ground with a high angle of the foot is to be avoided and is indicative of an untrained gait. The striking of the ground with the knee of the front foot bent is also indicative of an untrained gait in that the stride is thereby shortened, unless the gait is of the second variety, in which propulsion is not gained by the heel of the front foot so much as by the falling forward of the weight of the trunk. A long stride may be gained in the second variety of gait by allowing the body to fall more completely, but it is checked by the forward leg. A long stride, therefore, in this variety of gait is obtained only by the expenditure of a greater strain on the muscles of the front of the thigh, and it is for this reason that a short stride is for ordinary use preferable in this variety of gait.

The swaying of the body sideways varies according to habit and muscular strength. When the muscles are all strong, there is but little side sway; when the muscles that hold the trunk upon the thigh are weakened, the body will swing to the outer side as the weight comes upon the leg to diminish the strain upon these muscles. Not infrequently, however, when the individual pushes with the rear foot somewhat obliquely, the whole figure is pushed from the ankle upward to the outer side and slightly forward. In the ordinary gait there is but slight rise and fall of the hips as the weight comes alternately upon one foot or upon the other, but in some individuals this may be considerable.

The amount of rise and fall will depend upon the length of the stride and also upon whether the knees are bent and straightened in the different parts of the step. In a shuffling gait there are but little rise and fall; in a strong stride the rise and fall are uniform and considerable.

The cross axis of the pelvis is held during the walk at right angles to the direction of motion, and a slight sway takes place as the foot is thrust forward. In track walking this is artificially exaggerated in order to lengthen the stride, the individual swinging forward and the front of the rear foot twisting his pelvis forward in the direction of the front foot. As the legs are thrust forward in ordinary gait a compensatory swing of the arms takes place, the arm opposite the protruding leg being swung forward. The amount of this swing depends upon the rapidity of the gait and the activity of the stride.

These less important variations need to be carefully noted by any one wishing to familiarize himself with the peculiarities of gait, but for the practical purpose of the clinician it is necessary to bear in mind only a few of the points herein suggested, as follows: that there are two varieties of human gait besides what is known as a run, and that of these that in which the body is held erect, the weight being well behind the front foot, is the most common in civilized communities. The other variety is common among barefooted savages. That in the erect gait the heel of the front foot is important as a means of pulling the body forward, as is also the front of the forward foot as soon as the weight of the trunk is brought over the forward leg; the front of the rear foot is also used as a means of propulsion in the final push.

The importance of the front of the foot in gait should lead to greater care in construction of footwear, and in the prevention of weakening the muscles by shoes; and in gymnasiums, and in training men for marching, greater attention should be paid to the development of the muscles regulating the front of the foot, in the toes, and in the development of muscles that will enable them to utilize the forward gait. Troops sent in rapid pursuit of Indians or moccasined people should be trained in such a way that they should not be outclassed by the special muscular development of the people who can utilize thoroughly the economy of their forces in walking.

FIG. 10.—Spanish prisoners embarking at Santiago, showing the gait of exhausted men. The figure in the center is of a Cuban and indicates the leisure gait of strength. The figure to the left is that of an American soldier.

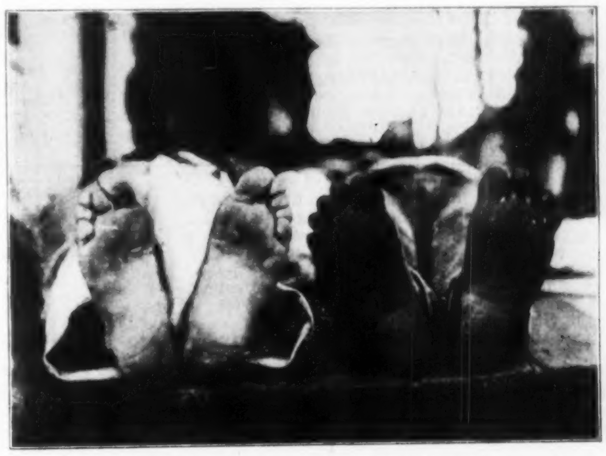


FIG. 11.—Photographs of the soles of the feet, one of an individual who has worn shoes, showing the weakened muscles and the cramped condition of the toes; the other of an individual who has never worn shoes, showing the strong condition of the foot muscles and of the toes. Photograph from the Caroline Islands.

FIG. 13.—Photograph of a child beginning to walk showing the claw-like position of the toes.

FIG. 12.—Gait of baboon, showing the claw-like action of the toes.

NOTES UPON THE EARLY HISTORY OF GAS MANUFACTURE.*

By H. C. SLANEY.

In this short paper upon gas works and their accessories it is impossible to give but a cursory glance of a business that has been constantly before the public in one way or another for the past 100 years, and in this connection it would not be amiss to call your attention to the fact that the gas industry as a commercial enterprise in this country is now passing out of its first century.

The 19th century has furnished many men of genius who, by their labor, have extracted from Mother Earth more domestic economies for aiding human progress than all departed centuries. Let us look back to the beginning of this century and consider how the human family ever made any progress with its numerous drawbacks. Among these was the mode of lighting, both in private houses and public highways, for genius in that early period had made some little progress in the art of lighting. Imagine, if you can, from your brilliantly lighted surroundings, how dismal the streets looked when lighted by crude oil lanterns with their cups of oil and pieces of rag for wicks, and how radiant a room must have looked when illuminated with its lonesome candle.

A gas works in its primitive state consisted of only two essential parts, the generative and storing, while to-day, with its numerous interposing apparatus, it has advanced to a state that is not so readily comprehended. Gas works and their surroundings from their first inception were and are to-day generally considered a public nuisance, but their products are a great blessing and a necessity to the community. Gas companies in the early period of their existence had hard struggles and sore trials, which resulted principally from two sources—prejudice and the want of knowledge. Curious as it may appear, the obnoxious gases which arise from gas-producing plants are not injurious to the workmen employed, and are a protection to the immediate community during epidemics of dreaded fevers, a fact which has been observed in several cities during the yellow fever scourge.

The history of the first discovery of gas as given in books of reference is somewhat different. As we are obliged to draw our conclusions from some older source I shall take the liberty of abstracting a few notes from Parnell's "Applied Chemistry," which says:

"Although the application of the gases produced by the destructive distillation of pit coal as a means of procuring artificial light is of modern invention, yet the germ of it may be traced back nearly 200 years.

"In the year 1659 Thomas Shirley is said to have attributed the exhalation from the burning well of Wigan, in Lancashire, England, to the subjacent coal beds; and soon after Mr. Clayton, rector of Crofton, at Wakefield, in Yorkshire, actually prepared gas by the distillation of coal."

In 1726 Dr. Stephen Hale distilled gas from coal, obtaining 180 cubic inches of inflammable air from 158 grains of New Castle coal. This seems to be the first instance in which a record was made of the quantity extracted.

In 1787 Lord Dundonald patented a process for extracting coal tar. He erected ovens or retorts, and the issuing gas was burned for amusement, but he attached no importance to the experiment.

Then there is a lapse of over sixty years before any advances were made to secure the awaiting prize. Lord Dundonald did not regard the gas evolved from his process as having any intrinsic value. During its development the gas industry, like many other enterprises, was a series of accidents, for it cannot be said that miners did not know of gases and the danger from igniting them, although it never occurred to them that the escaping gas from coal could be secured and utilized for practical purposes.

In France, about 1785, Philip le Bon, an engineer, claimed to procure gas for artificial lighting, but Le Bon made no communication of his invention until about 1799. In 1801 he took out a patent for a "gas fit for illumination." His gas seems to have been distilled from wood.

What has been considered as the first tangible application of coal gas in artificial illumination was made in 1792 at Redruth, in Cornwall, England, by William Murdock, engineer to Messrs. Bolton & Watt; this attempt did not extend beyond his own residence and offices. In the experiment he distilled the coal in iron retorts and conveyed the gas through tinned iron and copper tubes to a distance of 70 feet. Mr. Murdock erected another gas apparatus in Ayrshire in 1797.

Mr. Murdock, in 1798, erected what may be designated as the first gas works at the foundry of Messrs. Bolton & Watt, at Soho. This mode of illumination did not attract public attention until about 1802, when the front of the Soho foundry was lighted. In 1804 the public became very much interested by the numerous displays of the novel "smoke light" introduced by several inventors.

In lighting the cotton mills of Philip & Lee, at Manchester, Mr. Murdock erected an apparatus with a capacity of about 1,250 cubic feet per hour, using 900 burners to illuminate the mill, equal to about 2,500 candles.

Samuel Clegg, who was a pupil of Murdock, next claimed attention by his numerous inventions of gas apparatus, and it was to his ability as a mechanic that most progress was made in the art. Among his many inventions three were essential to the advancement of gas making, and with all the improvements that have since been devised they have not been superseded. These were the hydraulic main with its dip pipes for isolating the retorts, mouth pieces and the mode of attaching them to the retort, and the gas meter.

Frederick Winsor was an enthusiastic worker, and he did more to dissipate prejudice and bring gas into public notice than any other individual. He wrote letters, published pamphlets, and gave lectures upon the usefulness of gas. In one of his demonstrations with gas before a large audience the gas was so impure that the audience, while appreciating the evidence of its brilliancy, could not stand the smell of the burning gas. Winsor, in describing his process, says: "The gaslight apparatus consists of two principal parts—the one to carbonize coals, etc., and extract the smoke by heat, and the other serves to cool, decompose, and refine the smoke. Both vessels must be made air tight to obtain a perfect analysis of coal or other fuel and combustibles." The magnitude of one of his projected schemes is described as follows: "Winsor then proposed to light the parish of St. James. This included 65,500 lineal feet of iron piping, six stoves in various parts of the parish, with ten men and a boy to each." From this it will be observed that no attempt had been made to purify the gas, but simply to furnish a light to replace the oil lamp lighting.

Fig. 1 is a modified sketch of a gas works taken from King's Treatise on Coal Gas, and is supposed to represent the gas apparatus used by Mr. Winsor to illustrate his lectures (1804 to 1810). Although this sketch does not correspond with his above description, as this has

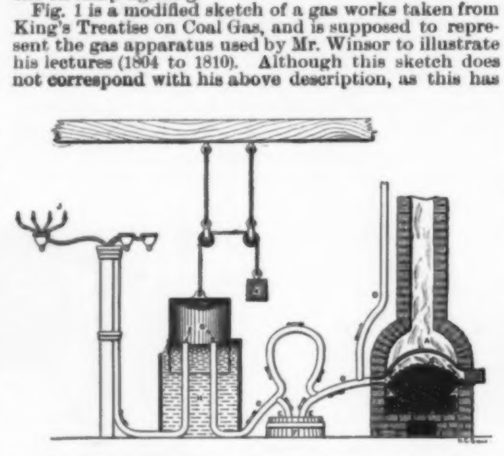


FIG. 1.—WINSOR'S EXPERIMENTAL GAS APPARATUS.

three parts, yet it clearly describes his crude process. The broken bituminous coal is charged into retort, *B*, through the large opening, which is closed with a plug. When the fire in furnace, *A*, becomes sufficiently hot, it heats the coal in the retort and drives off the volatile matter. The gas, as it is evolved, is forced from the retort by its own pressure and passes out of the retort through the pipe, *C*, and then into holder, *G*, where it is stored for future use. As this gas is distilled from the coal, it contains considerable tar and other liquids which run down the pipe, *E*; the tar, by gravity, will fall into the barrel, *F*, through pipe, *E*, while the gas passes over the loop in pipe, *C*, to be cooled and condensed, the remaining tar being dropped into the second pipe, *E*. The water in tank, *H*, permits the holder, *G*, to rise and descend, as more or less gas is made from the coal in the retort. The weight, *K*, is to counterweight the holder and give the proper pressure to the burners, *J*, where the gas is consumed. The burners, it will be noticed, are fashioned after the flame of a common candle; in fact, as all burners were at that time. The pipe, *D*, is used to take off the carbonic acid gas at the beginning of each heat, and also to burn off any surplus gas that may be on hand at the end of each experiment.

In 1809 Mr. Winsor secured a charter and established the National Light and Heat Company, with the power to lay pipes and supply the general public with gas.

Fig. 2 is the next advancement in gas making, and represents B. Cook's gas apparatus, which was taken from Cooper's book on gas lights, one of the earliest books on the subject, published in Philadelphia in 1816. Cook's description of this apparatus is rather quaint. It was designed in Birmingham, England, about 1810. *A* was a fireplace, above which was suspended a cast iron pot, *B*, holding from 25 to 100 pounds of coal, hanging by a chain attached to the "bewels" at the top edge of the carbonizing pot. The cover, *C*, had a conical joint, luted and wedged in place, and held the end of the pipe, *D*, while the other end fits into a seal, *G*, at the entrance of the washer or "purifier," *H*, which contained water. The sheets, *KK*, are soldered to the iron top and fastened to the wooden bottom, the latter being provided with a plug for drawing "off the ammoniacal water and tar as it is deposited," and the top having a valve for burning the surplus gas not required by the holder. The lead pipe, *M*, is provided with a drip, *R*, to catch condensed tar. A tank, *S*, contains a riveted sheet iron holder, *O*, supported by a counterweight, *T*, attached to a rope and the pulleys, *U*. The earthen jars, *R*, were emptied occasionally and "fresh water put in, as also the water in the vessel, *S*, must be changed to keep it clean and sweet; and the water in the purifier, *H*, should be changed every two or three days; by this means the gas will be deprived of its smell, at least as far as washing will effect it." *Q* is a valve which could be locked to prevent workmen wasting the gas. Two fireplaces and carbonizing pots are recommended, one being cooled and cleaned while the other is in operation. It is also recommended to add a second purifier containing water to which a few lumps of lime have been added. This apparatus is interesting by reason of its similarity to later forms. Although the present form of retort had not yet appeared, it did so in the apparatus attributed to Clegg, as described in the Monthly Magazine of June, 1815.

Fig. 3 represents Clegg's gas apparatus. *A* is a 3-foot retort closed at *B* by a door, *C*, held in place by a screw at its center, *D*. Fuel is placed upon the grate, *R*, the gases of combustion passing through the "flue," *S*, and the damper, *T*. The iron retort was protected underneath by a cast iron plate from the heated fireplace. *E* is a cast iron pipe conducting the gas to the cast iron "refrigerator," *F*, from which the tar was drawn off by the copper pipe, *P*. The bell, *H*, is connected by means of *G* to *F*, and contains small openings through which the gas bubbles into the gas holder; the latter was made of wrought iron plates, counterbalanced by the weights, *O*, suspended from a chain, *N L*, and pulleys, *M*. Two iron stays, *K K*, strengthened the holder, which was luted to keep tight and painted. The gas

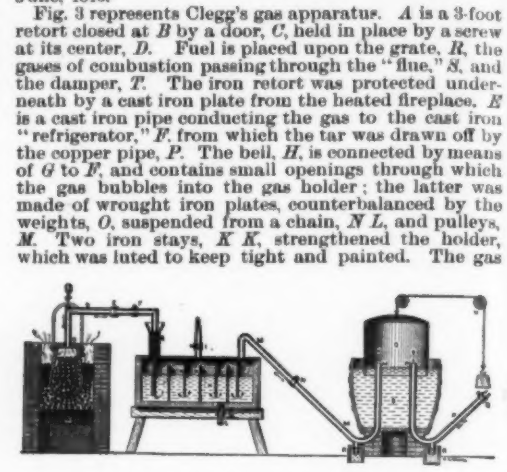


FIG. 2.—COOK'S GAS APPARATUS.

made its exit through small holes in the top of the pipe, *J*, and was led thence to the burners.

While the question of gas was agitating the public of Europe, it was also attracting some attention in America. Owing to the scarcity of gas literature of that period, information of its first installation in the United States is hard to obtain, but we find that it was introduced by Ambrose & Company in 1796 in the city of Philadelphia, showing its existence here for over one hundred years.

In 1806 David Melville, of Newport, R. I., lighted his house with gas of his own manufacture. In 1810 Melville procured a patent for a "gas lamp for lighting manufactories, mills, theaters, etc., with hydrogen gas or inflammable air produced from pit coal."

In 1813 Melville utilized his process by lighting the Wenscutt Mills, R. I. In 1817 his process was applied to Beaver Tail Lighthouse. This was the first application of gas for this purpose.

As early as 1815 James McMurtrie made a proposal to the city council to light the streets of Philadelphia with gas.

In April, 1816, Dr. Benjamin Kugler, of Philadelphia, made gas under the stairs in the steeple of the State House for some months. In November of the same year he lighted up the Chestnut Street Theater. This was successfully done until the theater was destroyed by fire in April, 1820.

Dr. Kugler went to Baltimore in 1816 and gave an exhibition of his mode of lighting in Peale's Museum in the City Hall. This exhibition so interested Mr. Peale that he formed the Gas Light Company of Baltimore. The city of Baltimore had the first authentic established gas works in America. It is said that the original works of this company was built to manufacture gas from resin, but after a few years' working was then changed to coal gas works. The gas storage capacity

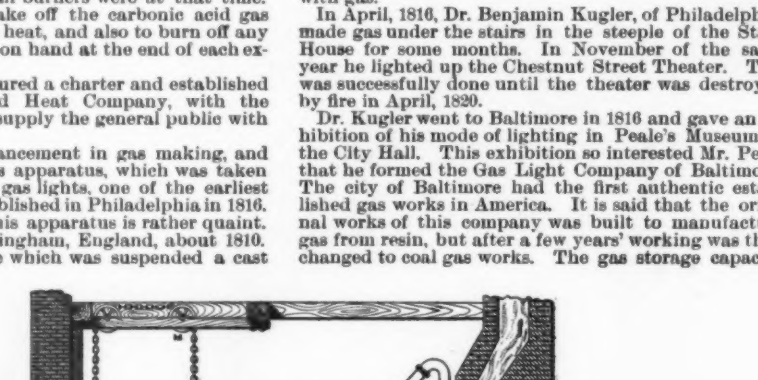


FIG. 3.—CLEGG'S GAS APPARATUS.

consisted of two small single section holders, the tanks of which were built of wood, resembling large tubs, and were reinforced by heavy iron bands, and these were inclosed in houses.

After Baltimore came the city of Boston, the next works being established there in 1822; then followed New York with two companies. The accessibility to cheaper light-giving materials, as tallow, resin, whale and other oils, and the high price of gas created but little demand for their product, and from 1817 to 1830 these four were the only works erected. The reverse was the case in England, where works sprang up like mushrooms, until as early as 1829 there were about 200 in Great Britain.

In New York, the first works to be established was that of the New York Light Company. A grant, as it was termed, was executed May 12, 1823, and was to extend over a period of thirty years. The works was erected on the corner of Hester and Rynders (now Center) Streets. Recently a relic of this works, in the

*Paper read before the Brooklyn Engineers' Club at one of the weekly meetings held at the Brooklyn Library on April 27.—From the Progressive Age.

shape of an iron tank, was exposed in tearing down some old buildings. The grant extended across the city and included that portion of the city south of Grand Street. This company manufactured resin gas exclusively from 1824 to 1848, and its product sold for $10 per 1,000 cubic feet.

About ten years later, May 8, 1833, the second grant was issued to the Manhattan Gas Company. This grant included the territory lying between Grand and Sixth Streets, afterward extended north to Forty-second Street. This company made gas from oil, then resin, until about 1849.

In 1835 the city of Philadelphia gas works was established by the municipality under the supervision of gas trustees. From this date and during a period of forty years coal gas works were erected in many cities, and as the application of gas to various arts became better known, the consumption of gas increased; many improvements were made to the plants; as these were added, the yield per pound of coal was increased, new systems of working were inaugurated, which resulted in reducing the price of gas per thousand cubic feet to the consumer.

The introduction of what is known as water gas in the United States began in about 1873. Experiments upon water gas began some years before those on coal gas. Hydrogen gas was known as "inflammable air" in about 1780. From time to time many attempts have been made by different inventors to solve the question of hydrocarbon gas as a rival to coal gas.

The first practical water gas process was that invented by T. S. C. Lowe, of Norristown, Pa. The inventor erected a water gas plant at Phœnixville, Pa., in 1873; again at Trenton in 1875. A large plant was erected at Manayunk, Pa., having a capacity of 300,000 cubic feet per diem. After this, through the persistent efforts of George S. Dwight, it was successfully introduced into many of the large cities. There are living to-day coal gas engineers who predicted all kinds of dire calamities if this gas should be introduced, and they are at present at the head of many coal works where this gas is manufactured exclusively. Mr. Dwight was a hard fighter for water gas; he wrote pamphlets, answered criticisms in gas journals, and he lived to see the results of his labors.

Retorts were constructed in various forms, as revolving, circular, oval, and D shape, and were principally made of cast iron; after some time clay was adopted. They were placed in the furnace either vertically, slantingly, or horizontally. As the consumption of gas increased, and for convenience in working and getting better heats over the entire retort, the horizontal plan was generally adopted. Again, to obtain better results in carbonizing the coal from the same quantity of fuel, retorts were placed in ovens or benches, these benches containing settings of one to eleven or more retorts each. "Money is made and lost in the retort house" is a common expression with gas men, therefore it receives constant surveillance from the superintendent.

Although gas holders were invented as early as 1789 for other purposes than illuminating gas, the gasometers were not used in the first works, if we accept Mr. Clegg's description of the public illumination given at the Soho foundry, for he writes: "The apparatus was simply effected by fixing a retort in the fireplace of the house below and then conducting the gas issuing from thence into a copper vase."

Gas holders were, before the invention of gas meters, the only method by which the quantity of gas could be ascertained. The storage of gas in these gasometers, as they were called, was a nightmare in the minds of many brilliant men of that period. Two instances of these conceptions may be mentioned here. Sir Humphry Davy inquired in a sarcastic manner if he, Mr. Clegg, intended to take the dome of St. Paul's for a gasometer. Mr. Clegg in reply stated that he hoped to see the day when gasometers would be not much less. Again, Sir Joseph Banks recommended to Parliament that no gasometer should contain more than 6,000 cubic feet of gas and that they should be inclosed in strong brick buildings. In this age of daring enterprise what would their surprise and amazement be if they could behold the mammoth inverted cups rising out of the metropolis and towering above many of the tall church spires?

The holders at first were very small and constructed in cylindrical form; as their size was enlarged, their form changed to the rectangular and square shape, and these were strengthened with a wooden frame and iron braces. Mr. Clegg invented a semi-circular holder, which he called a rotary holder. He took out another patent for a collapsing holder which was constructed like an △, and was hinged at the top, the sides collapsing or falling together. This form of holder needed only a shallow tank, but it was found very difficult to keep gas-tight and was soon abandoned. The circular or round holder superseded these, and has remained in use ever since, excepting that to increase its capacity with a minimum space, an extra lift was added, then another, until the fourth section has been reached, giving it the name of telescopic. In this form they have gradually increased in size, until now it is not an uncommon sight to see them approaching the 200-foot diameter mark in this country, while the capacity augments to about 5,000,000 feet. To overcome the increased pressure caused by using heavier iron in their construction, all gas holders were suspended by counter weights, thus reducing their pressure from two to three inches. This was the condition until within a few years; to-day the tendency is toward heavier holders to give more pressure.

In modern works the manufacture of coal-gas from the charging of coal into the retort until it reaches the holder is a series of operations, and the gas, in its transition from distillation to distribution, passes through various apparatus to complete its purification. Beginning with the retort, where the gas is extracted, it then passes up the stand-pipe into the hydraulic main, then to the scrubber, washer, exhauster, purifiers, meters (where the gas is first measured), and then to the holder for storage; from the holder it goes through the governor, where the pressure is regulated before passing to the distributing mains, thence through the service pipes to the consumers' meters, where the second measurement is made. The difference between these two measurements is attributed to leakage. After passing the last meter it becomes the property of the consumers, who can burn it or waste it at their pleasure. It can be safely said that the gas, from its liberation in the retort until it reaches the consumers, is constantly moving, and has passed through many miles of mains in search of a consumer.

HOW A BELL IS TUNED.

IF we open a circular of a bell founder, we shall invariably find therein the following assertion: "I guarantee to furnish at the outset a perfectly tuned bell that will require no subsequent correction." This price-list phrase has, like all of its kind, merely relative value. The bell, in fact, is a musical instrument of too complex a form and one of which the theory is too imperfect to allow promises of this nature to be kept. Although it is possible actually to obtain at the outset, in clock and hand bells, an accord that is nearly acceptable, unlooked-for accidents in fusion have to be contended with when it becomes a question of bells that weigh hundreds and thousands of pounds. Since difficulties present themselves even with small castings of

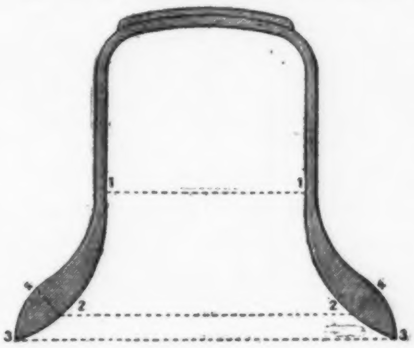


FIG. 2.—DIAGRAM SHOWING THE PARTS TO BE OPERATED UPON IN ORDER TO LOWER OR RAISE THE TONE OF A BELL.

no value, it is unnecessary to say that they increase when it becomes a question of a bronze casting of great weight.

If, moreover, bell founders were so sure of themselves, we should not hear so many false notes and disagreeable melodies proceed from our belfries, nor should we, in foundries, find those lathes of various styles that are in constant use.

The bell tuner, however mercenary be his calling, therefore really exists in flesh and bone; and if he were called upon every time that there was need of his services, he would not remain very long without business. A few data as to the subject of his industry will, we think, be of a nature to interest our readers.

The bell, which is a musical instrument, may be likened to an organ pipe, and the physical laws of the latter are therefore applicable to it in a general way. Consequently, of two bells of identical external aspect and of the same total diameter, the thinnest will give the lowest note; and of two bells of equal thickness and of equal diameter, the shortest will give the highest note. Therefore, in order to raise the tone of a bell, it will be necessary to lessen its bevel in order to shorten it; and in order to lower its note, it will suffice to ream it out in order to increase its diameter.

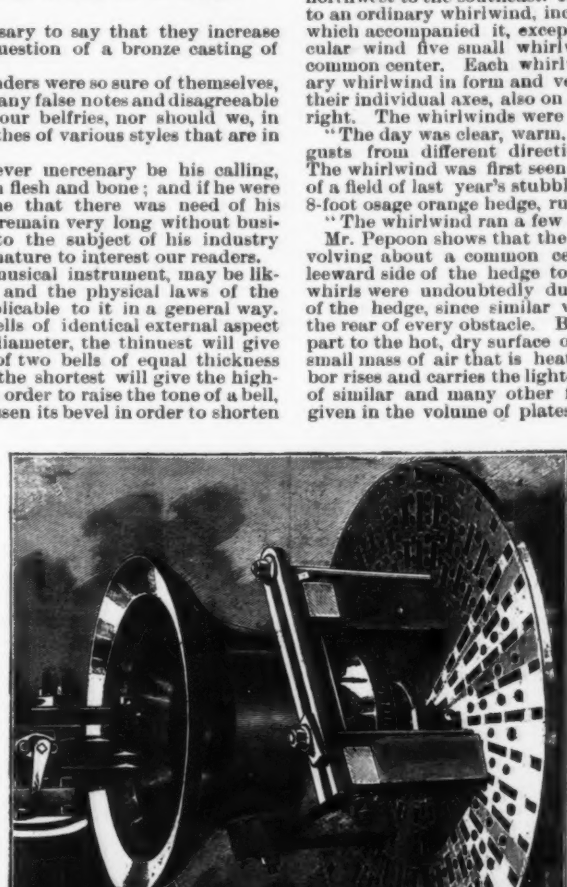


FIG. 1.—THE HOUR BELL OF THE GENEVA CATHEDRAL UPON THE LATHE.

Fig. 1 represents the large hour bell of the cathedral of Saint-Pierre, at Geneva, upon the lathe of the Ateliers de Construction of Vevey. This bell weighs 3,542 pounds and gives the note mi.

The operation of tuning is performed as follows. The bell is placed upon the lathe and firmly fixed thereto by the crown (Fig. 2). If it be desired to lower the note, a tool is placed opposite the swell (at 1), and the bell is slowly revolved so as to detach a thin shaving of bronze. The operation is continued, and more and more metal is removed as far as to the rim (at 2). Meanwhile, the bell emits a continuous sound, of which the tonality becomes lower and lower. The tuner, who must possess a perfectly correct ear, compares this sound with the vibration of his tuning fork. As soon as the latter and the bell vibrate in unison, he stops the motion, and the operation is finished. Thereafter the bell may mingle its sound with that of its companions without any danger of putting their melody out of tune.

When it is a question of raising the note, the bell is placed on the lathe as in the preceding case, and the tool is placed opposite the mouth and made to attack the edge. In measure as the operation proceeds, the sound emitted by the bell becomes sharper. The moment at which the exact note is reached is shown by the tuning fork. It may be readily seen that it is easier to lower the tone of a bell than it is to raise it. Unless a bell has a very strong bevel, beginning with the rim, it can scarcely be raised more than a semitone. In order to attain more than this, it would be necessary to render the edge absolutely flat and, moreover, to give the bell an unsightly form. Sonorous bells generally possess a thickness greater than that of the limit (one-fourteenth of the diameter), and one that permits of reaming them sufficiently to lower their note by a tone. There are certain bells, such as the 7,920 pound one of Mortreux, that are so thick that they might easily be rendered two tones graver.

M. Thybaud, the Swiss tuner from whom these data were obtained, is now busy harmonizing the curious chimes of Lausanne, which consist of twelve bells that give but seven different notes, and which are distributed between three contiguous belfries. The following is the weight of these bells; a la flat of 14,520 pounds; two do weighing respectively 7,920 and 4,620 pounds; two mi flat of 3,740 and 2,970 pounds; one fa of 2,057 pounds; two la flat, octaves of the first, and weighing respectively 1,670 and 1,110 pounds; two si flat of 814 and 772 pounds; and, finally, two do, octaves of the preceding, of 803 and 546 pounds.

For the above particulars and the illustrations we are indebted to La Nature.

DUST WHIRLS AND FAIRY DANCES.

MR. O. C. PEPOON, of Medicine Lodge, Barber County, Kans., sends the following description of a dust whirl observed at that place in the summer of 1897:

"In the summer of 1897, the exact date is forgotten, at about 3 P. M., I noticed a whirlwind moving from the northwest to the southeast. It was in every way similar to an ordinary whirlwind, including the straight wind which accompanied it, except that instead of one circular wind five small whirlwinds whirled around a common center. Each whirlwind resembled an ordinary whirlwind in form and velocity. They whirled on their individual axes, also on their common axis, to the right. The whirlwinds were about 15 feet high.

"The day was clear, warm, and still, with occasional gusts from different directions, generally westerly. The whirlwind was first seen at the northwest corner of a field of last year's stubble, at the north end of an 8-foot osage orange hedge, running south.

"The whirlwind ran a few rods and vanished."

Mr. Pepoon shows that the system of little whirls revolving about a common center was formed on the leeward side of the hedge to which he refers. These whirls were undoubtedly due in part to the presence of the hedge, since similar whirls are encountered in the rear of every obstacle. But they were also due in part to the hot, dry surface of the ground, since every small mass of air that is heated hotter than its neighbor rises and carries the lightest dust with it. Pictures of similar and many other forms of dust whirls are given in the volume of plates accompanying the work on whirlwinds and duststorms of India by P. F. H. Baddeley, London, 1860. He gives diagrams showing several dust whirls rushing along one after the other until finally all combine into one large whirl; or again, a group of thirty or forty whirls forming a continuous series like the front of an advancing squad of soldiers, or even circling around a central region like the outside boundary of a tornado. His diagrams suggest that in some cases a circle of dust storms, representing ascending whirls, incloses an area in which the air is descending, but this may be an hypothesis of the author and not the result of actual observation. Baddeley was a very enthusiastic student of the subject, and followed these whirls on horseback or in a buggy, note book and pencil in hand, noting and sketching as he went along. He attributes to electrical action the phenomena that we believe can easily be explained without electricity as being due simply to the wind and the heat. He says that:

"Dust whirlwinds are common in all parts of India,

especially during the dry season. Sometimes a slender lofty cylindrical pillar of dust is seen revolving on its axis, or several such pillars moving on together in the same direction, or revolving in a circle, or as a dense cloud of dust sweeping over the country like a tornado, the cloud of dust occasionally presenting to the view a distinctly columnar structure. In northern India the smaller whirlwinds appear in dry, windy weather. They occur with singular regularity during the middle of the day. Sometimes a slowly-moving whirlwind instead of appearing as a simple column is found to be composed of several distinct vortices, each one rotating on its axis as it revolves around in the whirling circle. Each separate vortex has attached to it a fan-shaped train of dust.

"This remarkable sight gives the idea of a fairy dance round a ring, and the motions are, from all accounts, exactly imitated by the dancing dervishes of Turkey, one of their holy exercises being to whirl round and round like a top, singly, or in company with several others, performing at the same time a gyration round in a circle, as if their dance originated in the very phenomenon now described. We may sometimes watch this motion for a length of time without changing our position more than a few yards."

Mr. Baddeley says that—

"The essential portion of the whirlwind always appeared to him as a lofty cylindrical pillar preserving apparently the same diameter throughout its entire height for thousands of feet. A dust storm or tornado is occasioned by an accumulation of whirlwind columns moving en masse or in rapid succession over the earth's surface in a direct or wavy line. Thousands of these spiral columns pass by in one direction during six or seven hours of the hottest portion of the day, and on other days repass in another direction as if a host was mustering for battle."

Among the numerous details given by Baddeley, we quote the curious fact stated by him:

"Birds, such as kites and vultures, are often seen soaring high up just above and around these dust whirlwinds, following them for some distance, soaring about and around them, diving at each other as if in sport, keeping pace with them, seemingly with no other purpose than that of enjoyment."

The reader will find a very interesting description of mechanical methods of forming whirling columns of air with the attending dust whirls and waterspouts in a French work on tourbillons, by Weyher. The method adopted by him consists in placing a wheel or fan at some distance above a basin of water or table covered with dust. The rapid horizontal rotation of the fan sets all the air of the room in motion, producing a spiral ascending whirl over the table, having a crude resemblance to a dust whirl, waterspout, or tornado.

Much more natural imitations of the atmospheric dust whirls have been made and described by Vettin in the Annalen für Physik und Chemie for 1856 and 1857. Experiments of this kind have lately been carried out quite perfectly by one of America's most skillful experimentalists, Prof. R. W. Wood, of Madison, Wis. (See an article by him entitled Some Experiments on Artificial Mirages and Tornadoes, L. E. D. Phil. Mag., April, 1899, vol. xlvii., p. 349.) Prof. Wood uses flat metal plates about a yard long and a foot wide covered with a little sand. By heating the plates the air above the sand becomes warmed and produces mirage effects; but when heated still hotter, most beautiful little whirlwinds of rising hot air can be seen running about over the surface and carrying up the fine silica powder that is scattered upon the plate. When sal ammoniac is used instead of silica, dense clouds of white vapor immediately arise, and he has observed a most perfect miniature tornado of dense smoke about two yards high.

The preceding notes suffice to show how eddies and whirls of dust are formed on the hot plains of Kansas. It seems natural to infer that special combinations of winds and temperature may give rise to the large whirls or waterspouts and tornadoes, but we think it more likely that the latter have an analogous but slightly different origin. The solar rays that heat the ground on a clear day have an effect analogous to that of those rays that are stopped by the clouds in ordinary weather. In the formation of a waterspout, it is quite common to see its slender axis form at the base of a cloud and descend toward the sea level. This has been properly explained by Ferrel, who showed that the velocity of gyration can easily be very much greater high above the earth's surface than lower down, and that the cloud that is formed in the region of low pressure along the axis of the whirl must begin at the upper end of the waterspout and grow downward. The whirls in both waterspouts and tornadoes are, therefore, explained mechanically as originating in the clouds and extending downward, under favorable conditions, to the earth's surface. It is only the small dust whirls that originate at the earth's surface, and only in rare cases do these extend upward to the clouds.—Monthly Weather Review.

SEEDLESS GRAPES.

Herr Muller-Thurgau attributes the absence of seeds in many varieties of grapes sold in the markets to two causes—functional inefficiency of the pollen and of the ovule. In some varieties the pollen-grains are well developed, but either the pollen-tubes do not reach the ovules or the ovules are themselves incapable of impregnation. To this class belong the sultana raisins and the currants of commerce. In other varieties, on the other hand, the ovules are perfect and capable of impregnation, but the pollen-grains are functionally defective; either the pollen-tubes do not germinate on the stigma, or they are incapable of impregnating the ovules. Grapes which do not contain seeds are smaller than those which do.—Landwirthsch. Jahrb. d. Schweiz, 1898.

The steel used by the Standard Steel Works, Philadelphia, for making railway tires under American specification, has the following composition: Carbon, 0·65 to 0·75; phosphorus, under 0·05; silicon, under 0·25; manganese, 0·5 to 0·7; sulphur, under 0·05. The tensile strength runs from 110,000 pounds to 125,000 pounds, the elastic limit from 55,000 pounds to 65,000 pounds, and the elongation in 2 inches, 12 to 15 per cent.—The Engineer.

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